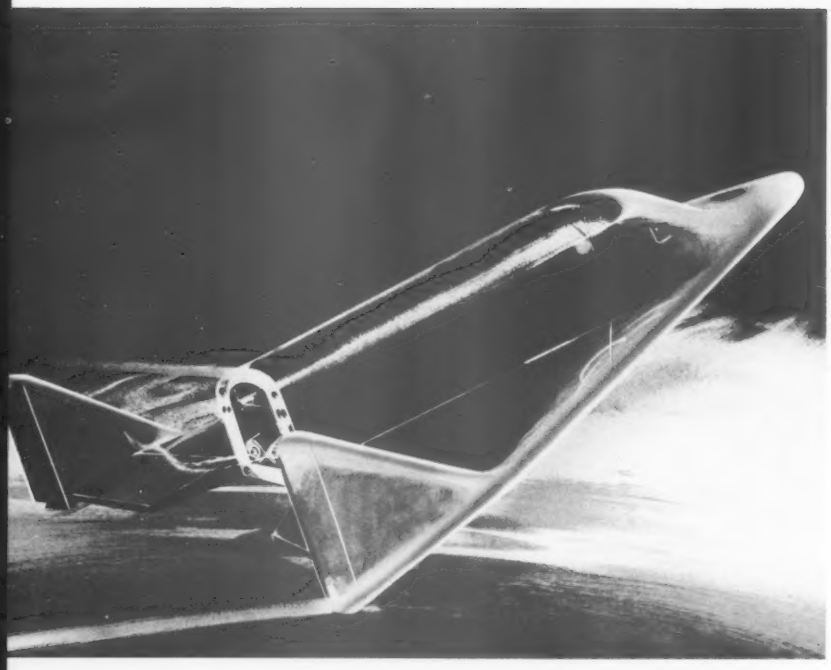
THE Airman

OCTOBER 1960

OFFICIAL JOURNAL OF THE AIR FORCE

PUBLICATIONS
OCT 4
CL

This is Dyna-Soar
page 10



A BLENDING OF STRENGTH FOR THE JOURNEY INTO SPACE

When Dyna-Soar embarks on its initial journey into the freedom of space, USAF's mighty TITAN ICBM will provide the thrust to sunder the bonds of gravity that have held man chained as a prisoner of Earth. The complete story of Dyna-Soar appears on page 10.

D 301.60:4 | 10

THE Airman

OFFICIAL JOURNAL OF THE AIR FORCE

Volume IV, Number 10 October 1960

Director of Information, Office of the Secretary of the Air Force, Maj. Gen. ARNO H. LUEHMAN. *Chief, Internal Information,* Col. ROGER B. PAYNE. *Editor,* Lt. Col. HARMON H. HARPER. *Assistant Editor,* Maj. ROBERT J. FLANAGAN. *Executive Editor,* TED R. STURM. *Departmental Editor,* SMSgt. HAROLD E. BAMFORD. *Art Director,* SMSgt. LESTER B. BOUNDS. *Production and Distribution,* RUSSELL M. WOODS.

USAF PERIODICAL 30-15

CONTENTS

THE BIRTH OF AN ERA 2
Man stands on the threshold of space

BEYOND THE WILD BLUE YONDER 4
Astronauts prepare for historic journey

THIS IS DYNA-SOAR 10
Space vehicle just over tomorrow's horizon

TITANIUM—METAL WITH A FUTURE 17
New usefulness for Cinderella metal

CONVALESCENT LEAVE 20
He talked his way out of the hospital to fly

UNITED NATIONS PEACELIFT 24
USAF support of the U. N. in the Congo

SATELLITE—SPACE PROBE SUMMARY 31
Compilation of facts on space effort

SINGLE-PLANE MISSION 32
He gave his life for his crew

SALUTE TO AN AMAZING AWOL 34
This foot soldier earned a niche in history

FROM MYNHEER HUYGENS TO MIDAS 38
Pioneer research in composition of light

THE IMPORTANCE OF YOUR VOTE 41
One of the major responsibilities of citizenship

FLIGHT PLANNING BY THE NUMBERS 42
Computers provide pilots with instant weather

MOVIES TELL THE STORY 45
More learning in less time through movies

DEPARTMENTS

LETTERS TO THE EDITOR 1 — YOU SHOULD KNOW . . 22
SLANTS ON SPACE . . . 18 — AIRMAN'S WORLD 26

Editorial Office: THE AIRMAN, Room 2-206 Tempo E, 4th and Adams Drive, S. W., Washington 25, D. C. Telephone, OXford 6-7393.

THE AIRMAN is primarily a medium for the exchange of ideas and information among Air Force personnel. Readers are encouraged to submit articles, short subjects, photographs, and artwork.

Use of funds for printing this publication approved by the Secretary of the Air Force and the Director of the Bureau of the Budget, June 9, 1959.

LETTERS TO THE EDITOR

More on OJT

Sir: Re the articles *Complacency in OJT* in your April issue and *Liberality in OJT*, July issue. As the old saying goes, "there are two sides to every story." We have now heard two stories about on-the-job training, both concerning *negativism* toward OJT. But it is a many faceted program. Peter blaming Paul and Harry blaming Bob settles nothing. When everyone, officer, NCO, and airman, faces up to the fact that he has a responsibility to train others or be trained, then and only then will the trend turn toward *positivism*. Like the soldier, sailor and marine, the duty of all airmen in peacetime is to train and prepare for war. If we fail to do this we're shirking our duty to the Air Force and our country. Let's not trust to luck—let's train.

TSgt. Harry Hagan
APO 123, New York, N. Y.

★ ★ ★

He liked It . . .

Sir: A break-through with the July issue of THE AIRMAN! The entire issue seems to have had a face-lifting treatment. I liked it!

W. E. Sayle
Technical Writing Division
Lackland AFB, Tex.

★ ★ ★

. . . But They Caught Us

Sir: Reference the picture on page 11 of the July issue. In counting the chevrons belonging to Sgt. Houser, I noted he is a MSgt., not a TSgt.

A1C Robert Palmer
APO 235, San Francisco, Calif.

Sir: Is the TSgt. in the picture on page 11 wearing MSgt. stripes or is he a MSgt. posing as a Tech or am I having delusions?

SSgt. C. L. Nelson
APO 616, New York, N. Y.

Sir: On page 11, July issue, you called a sergeant TSgt. who clearly wore the chevrons of a MSgt.

A1C Fronzell L. Spellmon
APO 323, San Francisco, Calif.

• *He is a MSgt. We goofed.*

★ ★ ★

(Continued on page 23)

THE

Heaven is not reached by a single bound;
But we build the ladder by which we rise
From the lowly earth to the vaulted skies
And we mount its summit round by round.

—JOSIAH GILBERT HOLLAND
in *Gradatim* (Gradually)

Sometimes you wonder how, or if, it is all related.

An Air Force officer rides a gondola beneath a giant balloon that takes him to the fringe of the earth's atmosphere; Miss Sam, an adventurous rhesus monkey, endures an accelerative force 14 times her own weight as NASA blasts her spaceward from Wallops Island, Va.; *Discoverer* shots rise from Vandenberg AFB; a scientist at the School of Aerospace Medicine takes an unsavory bite of algae; the X-15, a missile with a man in it, drops from beneath the wing of a mothering B-52 and tentatively tries its own stubby wings.

You sense that great things are about to happen; that you are a witness to history, the birth of an era. You wish you could understand everything that is happening and where it will eventually lead.

A new era *is* being born, but it doesn't just happen. Eras result from prolonged periods of gestation fraught with peaks of elation and troughs of discouragement, success and failure, practical application of known principles

and blind groping for new ones. But sustaining the great effort always is a goal toward which men struggle; to leave the earth's environment, to explore the infinities of space.

Had you lived through the 18th and 19th Centuries, you would have felt much the same bewilderment. Henson, Stringfellow, Lebris, Lilienthal, Pilcher —and hundreds of others spanning several centuries before the successful flight of the Wright Brothers—manifested the successes and failures of another era. There were balloon flights, gliders, gas bags, feathered wings, steam-powered models, research, study, derision, hope, and again the inevitable goal which sustained these efforts: to give wings to earthbound man.

Since 1949 when the V-2-*WAC Corporal* combination rocket blasted to heights of 250 miles above the earth—the first man-made object to leave the earth's atmosphere—the United States has added rung after rung to its space ladder. We have now reached what may well be the last few steps. *Project Mercury* will ultimately put a man in orbit around the earth. The X-15 will provide a vehicle which will operate in the "gray" area between the earth's atmosphere and true space. The *Dyna-Soar* is the next step. It will combine the knowledge gained from *Project Mercury*, the X-15, and progressive projects

BIRTH OF AN ERA

of yesteryears. It will allow man to take off from the earth's surface, travel a modest distance in cislunar space, return and land. A wedding of the ballistic missile and the manned aircraft, *Dyna-Soar* will be the first in a new generation of true spacecraft.

Characteristically, the national space program has as its purpose the peaceful exploration of the mysteries of our universe. But Americans are realistic. As long as there exists a threat to our way of life, the conquest of space will also have a dual, defense role emphasized by Lt. Gen. Bernard Schriever before the House Committee on Science and Astronautics early this year.

"From a national point of view progress in space research and the exploitation of space is essential—both for our national security and our scientific and technological prestige.

"The basic distinction between the Department of Defense and the Space Agency is this: The primary responsibility of the Department of Defense in the exploitation of space is the defense of the United States. The primary purpose of the Space Agency is the investigation of space for scientific and other peaceful purposes.

"Space for the military planner is a medium—not a product like an atomic bomb. It is a medium which promises a high potential for national defense that undoubtedly far exceeds the limited three-dimensional arena of land, sea, and air to which man has historically been confined."

BEYOND

BEFORE many more months have passed, the now familiar sight of a roaring missile, trailing a plume of white hot flame as its blasts into the sky, will proclaim a bold new venture of vital significance to the peoples of the Free World.

So far, to the average man in the street, the missile has been just an inanimate though impressive piece of defense hardware, and the increasing frequency of test launches has reached the point where the event is more or less a commonplace one in American life. But the day is fast approaching when man will no longer remain behind; when for the first time he will ride that flaming monster beyond the wild blue yonder. *Project Mercury* now stands at that challenging threshold.

Seven key men await that promised call, each confident the project can culminate only in success; for they—probably more than any other group in the world—realize the work and planning, the test and retest, and the myriad details that have brought them to the end of one road and the beginning of a completely unexplored stretch of new highway.

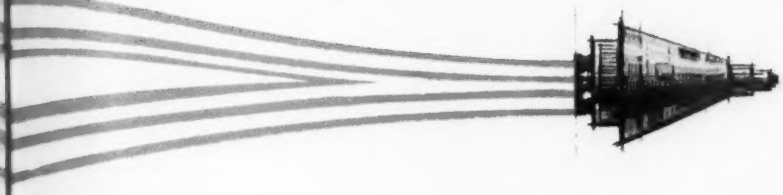
Precisely where or when the first man-in-space dream originated seems lost in antiquity, although Greek mythology holds it must have been spawned as soon as or before the dream of flight itself. Regardless of the date or place of origin, scientists have been sifting relevant data from a number of sources for decades.

It was not until the X-series aircraft program had shifted into driving gear, however, that some scientists realized they were much closer to the Buck Rogers era than many of their competent associates believed possible at such an early date.

First, the sound "barrier" crumbled before the assault of the X-1A, Capt. Chuck Yeager, and the on-rushing, but still unscheduled, space program. Within a very few additional weeks, Maj. Arthur Murray was hauling the same aircraft well beyond the 90,000-foot altitude mark. During the Fabulous Fifties, the roster of near-spacemen grew, reaching out to other services and several civilian agencies for additions.

Scientists are agreed that space, a relative, loosely used term, begins where the abundance of life-giving gases diminish—an area beginning about 10,000 feet and decreasing in atmospheric pressure to a level generally conceded to be about 63,000 feet above the earth's surface, where body fluids are no longer compressed by the weight of atmosphere and protective clothing is essential to life.

The next "layer" of space begins at about 90,000 feet where less than two percent of the atmosphere remains. Thus, Major Murray's flight was an important milestone in the perpetual quest for information, not only about protective clothing, but also in relatively unknown and mysterious subjects such as the hidden effects of cosmic radiation.



THE WILD BLUE YONDER

by SMSgt. Hal Bamford

The astronauts, opposite page, top to bottom, Lt. Col. John Glenn (USMC), Comdr. Alan Shepard, Lt. Comdr. Walter Schirra, and Lt. Scott Carpenter (USN). Above, top to bottom, Captains Leroy Cooper, Virgil Grissom, and Donald Slayton (USAF).

To this point in the program—and even beyond it into the more advanced X-2 program—tentative probings were measured in minutes and seconds, but it rapidly became obvious that the time man spent in this new environment must necessarily be expanded to hours to reap the required benefits from his first gropings on the very fringes of space.

Thus, *Project Man High* was conceived with the basic aim of testing man's reactions during several hours of prolonged exposure to heavy primary cosmic rays. The first tentative steps were scheduled for early 1956—almost simultaneously with the drawing-board birth of such advanced vehicles as North American's X-15.

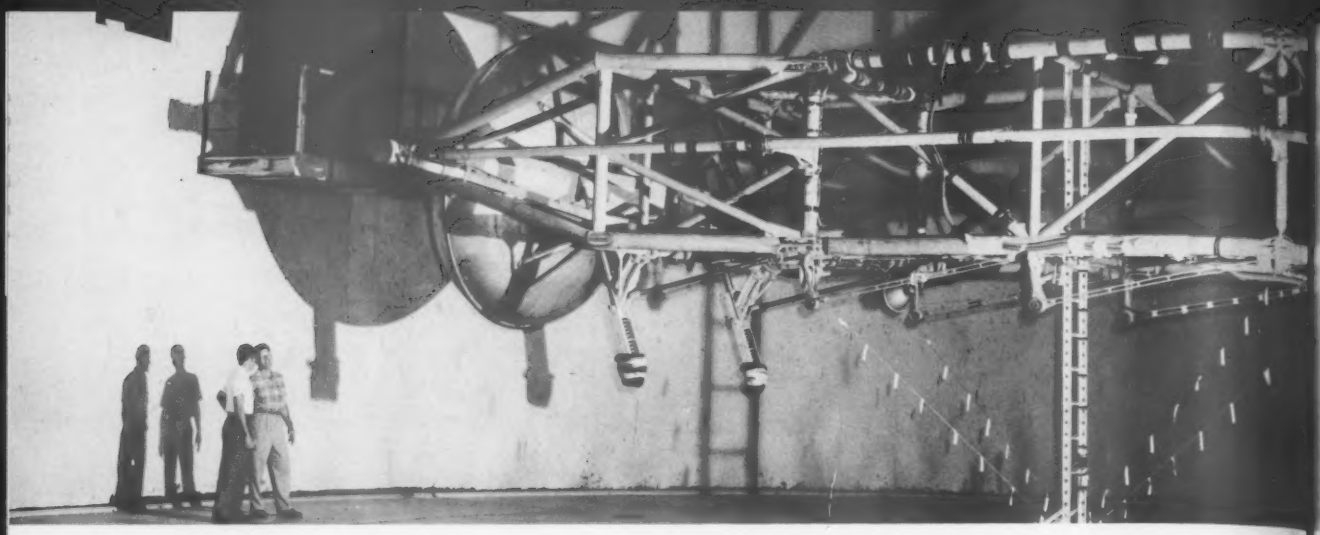
The accomplishments of Lt. Col. David Simons and his associates on the *Man High* project added critically needed data to many facets of the space program in general, and to the rapidly growing storehouse of knowledge about man's adaptability to the new environment.

In 1957, *Sputnik* changed many things, chiefly the still lingering belief of many that there was little practical value in man's conquest of space. Before the first satellites had long been in orbit, many diverse projects had changed direction, gained new impetus, and settled on new targets.

The X-series flight program had pushed man to remarkable new heights and speeds for brief periods. For example, on August 4 of this year, Joe Walker, NASA test pilot, recorded a new speed mark of 2196 m.p.h. in a brief four-minute flight. *Man High* had dispelled many fears regarding human ability to remain in space conditions for prolonged periods. Now, instrumented satellites were proving the ability to put the vehicle up there to feed information into the research hopper at an unprecedented rate. But still lacking in space was man himself.

This ultimate end was the focal point, however, for much of the thought and effort behind the program. The National Aeronautics and Space Administration, one of the principal partners in the X series and other related programs, emerged as the responsible agency into which was funneled the aggregate fruits of all labors. There they were welded together to form the nation's primary man-in-space program now known as *Project Mercury*.

Specifically, *Project Mercury's* principal announced objective is an exploration of man's capabilities in the environment he will face while undertaking space missions. This vast, cooperative program, is "chaired" by a civilian agency, NASA; participated in by innumerable civilian companies; and the armed forces. The seven astronauts who have been selected are Lt. Col. John Glenn from the Marine Corps; three captains: Leroy Cooper, Virgil Grissom, and Donald Slayton, from the Air Force; and Comdr. Alan Shepard, Lt. Comdr. Walter Schirra, and Lt. Scott Carpenter of the Navy.



Long sessions in the centrifuge are designed to reproduce and help the astronauts combat the high G-forces they will encounter during their mission.

Panel of the Mercury *capsule will differ widely from those of conventional aircraft.*

However, even with these many agencies, the prolonged research program, and the cross section of brillant minds involved in the program, enormous problems remained.

There are no research libraries to provide answers to many key questions—no one's been there before. It is a matter of carefully gathering bits of data from all space probes and satellites and in many cases, of filling in the gaps through extrapolation.

Coupled with the need to provide maximum assurance that the astronauts will return safely it becomes readily apparent that haste must be made slowly.

The chosen seven, each of whom is an engineer test pilot in his own right, have been working with designers and doctors for well over a year now. In that time, they have determined certain modifications which, in their minds, seemed to be absolutely necessary to the success of the mission. Some have been adopted, some have not. But, as Schirra pointed out, "most have been solved to our general satisfaction."

Each of these groups has conceded points where it became necessary to increase the chances of success. Where it was a question of comfort, as opposed to engineering necessity, comfort was sacrificed. Where it was physiological necessity against engineering practicality, the engineers have bowed to the medical officer's wishes.

The net result has been a generally harmonious operation. To be sure, there have been differences, but considering the diversity of the services and agencies involved, harmony has been the keynote.

The chosen astronaut is going to face a condition which has caused many medical men to scratch their heads and wonder at the complications which may ensue—the condition of weightlessness.

Close observation has shown that weightlessness produces in some subjects a sort of "who cares" attitude in which he feels completely divorced from worldly cares. In other cases, subjects experience nausea and vomiting. Because the *Mercury* capsule is equipped with controllers which allow its occupant to take complete charge, the medics have pondered the possibility that the first man out could, if he experiences this feeling of detachment, decide to stay there and flick off the outside control switches.

Most of the medics agree they may be whistling past the graveyard, but this item points up the type of unprecedented problems confronting nearly every phase of the program.

Five military doctors have been assigned to the project to assist astronauts and engineers in assuring the most complete possible physiological protection for the fliers. Chief among these is Lt. Col. William K. Douglas, USAF, who is the project flight surgeon. Also from the Air

Recovery crew training is nearly as thorough as that of the astronauts. The mission's success hinges largely upon the crew's efforts after capsule's return.

Lt. Comdr. Walter Schirra is "wired for sound" prior to undergoing one of the numerous tests conducted during the astronauts' exacting pre-flight training.

Force are Lt. Col. Stanley White, chief of the Life Systems Branch, and Lt. Col. James P. Henry, deputy chief. They are assisted by Capt. William S. Augerson, one of the Army's few flight surgeons and Lt. Robert B. Voas, USN, the psychologist and training officer.

To assure that this group has a complete understanding of the many problems they and the astronauts face, Colonel Douglas has taken the complete training program as an "eighth" astronaut, using the knowledge thus gained to guide the other doctors in reaching their decisions.

Additionally, the task of bridging the gap between astronauts and engineers when certain disagreements have occurred has fallen to this group. Their knowledge of the human body, coupled with astronaut requests and engineer limitations, have produced several compromises in equipment.

A case in point is the side-arm, three-axis controller, with which the flier will control the capsule's attitude once orbit has been achieved.

To provide maximum protection for the flier, form-fitting couches have been molded for each individual. At blast-off, he will be cradled in the couch flat on his back—a position which the doctors have determined provides the maximum ability to absorb the extreme G-forces which will be encountered.

However, it was also discovered that such a position produced other problems such as control operation. For example, foot pedals were impractical. Introduction of a new device was necessary—one which would allow operation with a minimum amount of body movement.

T. P. Schmaggs now proved his worth to the program. T. P. is an inanimate medical aide which duplicates the muscle and bone structure of the human body. Placed in a couch, it was determined that G-forces would probably immobilize the use of most body parts, but that the wrist, because of its construction, would be usable. The result was a small handle, ingeniously connected, which allows complete control of capsule attitudes by single-point activation of hydrogen peroxide jets.

As each of the seven astronauts is a pilot, this produced momentary problems also, but practice soon proved that the new device could be operated as efficiently as standard aircraft controls. And, as Carpenter points out, "Once orbit has been achieved, attitude will mean very little except for observational purposes." Tumbling in orbit, however, is a different matter which could be quite serious if unchecked.

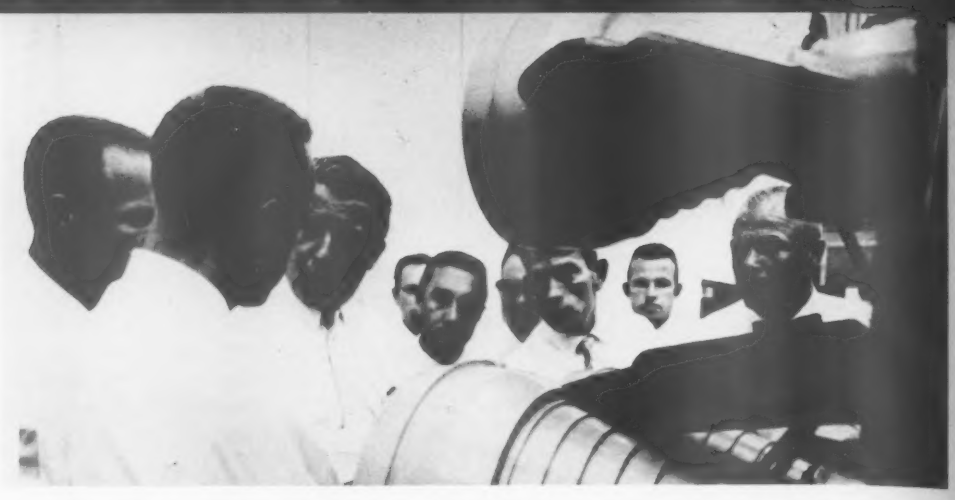
As noted earlier, every effort has been made to assure that the astronauts have all possible safety devices built into the vehicle. The pilot, for example, will be provided the means to control everything connected with the flight, up to and including aborting the mission.

Actually, three sets of abort controls have been provided. One is automatic and is called abort sensor control system. It operates through electronic devices and, should anything misfire which is not detectable by the human senses, this section automatically halts the mission progress regardless of the state it has reached. Second are the manual controllers operated by monitors at the launching site. And, finally, there is the "chicken-switch," so named by the astronauts themselves. It allows the pilot to kill the sequence at any time.

The value of these devices was dramatically illustrated late in July when an *Atlas* missile blew up during an unmanned *Mercury* capsule firing. Post-mission inspection proved beyond doubt that an astronaut would have been able to clear the launch vehicle without problems.

The same care has been provided for along the route which the capsule will follow in its orbital flight. A total of 17 tracking stations, nine of which were in existence even before the project was inaugurated, will keep constant watch on the vehicle. Six of these stations have "landing" capability. In addition, ships will remain on constant alert at sea to assure the fastest possible recovery after reentry.

The initial orbital mission is programmed as a three-orbit flight, each orbit approximately 90 minutes in duration. This means that within the



Because the initial space assault will employ the Army's Redstone *rocket as the launch vehicle, Wernher von Braun briefed the astronauts on its capabilities.*

Each astronaut has been fitted with his own specially constructed contour-type couch.

Weightlessness has provided the project's medics with a completely unique problem.

span of each hour and a half, the pilot will pass through a complete day-night cycle, and each revolution around the earth will be almost equally divided between light and dark.

Preliminary manned sub-orbital testing will be accomplished with the Army's *Redstone* rocket as the launch vehicle. Orbital missions will use USAF's *Atlas*. Consequently, because of the lifting limitations of these two, weight is a major factor.

If the identity of the chosen astronaut is known to anyone at this stage, it is probably one of the best kept secrets of all time. However, to indicate the importance of weight several engineers associated with the project have suggested that this factor may figure prominently in the final pilot selection. As the critical point is reached, the less the pilot weighs, the greater his chances become. The astronauts are aware of this and are pursuing semi-rigid, self-imposed diets.

Such volunteer actions illustrate the eagerness of each of the seven to be the "chosen" individual of the group. Almost without exception, they expressed the feeling that, while perfection has not been reached, nearly everything necessary for initial success has been accomplished.

This is no air of false bravado; rather it is the manifestation of extreme confidence in the future of the program and man's eventual progress into space. Each feels that further programs are certain to follow and thus he can contribute to the success of future spacemen even as aviation's pioneers contributed to theirs.

Many critics have suggested major slashes in aircraft funding because of satellite successes and the confidence that space flight is just around the corner. Cooper views such thinking as premature. "We confidently expect success," he notes, "but this does not mean the immediate death of aircraft. Let's face it, flight training is still the best available test bed, and aircraft are going to be necessary for years to come."

Shepard is quick to add that except for the fact that numbers will be larger in such areas as G-forces, and that equipment will be more complex, "the differences between present-day flight and that of the future will be small."

"Pilot-crew chief association will be more critical than ever before," claims Cooper. Yet, equipment will be so complex that specialists will do a larger share of the work than in the past, and the crew chief will probably attain a position of manager-psychologist. Thus, as is increasingly the case today, education will assume a greater role than ever before in Air Force history.

Retired Air Force General Clarence S. Irvine recently noted that "there is no compromise with or shortcut to the truth of the challenging tasks facing the Air Force and industry today. I for one am convinced we can meet that challenge." And the confidence which surrounds *Project Mercury* only echoes this feeling.

There I was, flat on my back, 100 miles up . . .

INEVITABLY, space flight projects have produced a number of new problems not the least of which is training the men themselves. Quite naturally, nothing has been spared to assure that the best possible solution may be reached before such a flight is attempted.

However, with no one having accomplished the feat, training devices have, of necessity, been constructed around principles gleaned from rocket tests, orbital firings, and years of research.

Project Mercury, the National Aeronautics and Space Administration's Space Task Group, has been training their seven astronauts in several such devices. One of these is the air-bearing simulator, a single-point machine which rides on air and is designed to parallel the actions of the capsule during the orbital phase of the proposed flight.

Viewed from the solid concrete floor on which it rests, the simulator gives the impression it might well have been produced by a slightly mad or thoroughly intoxicated washing-machine manufacturer. Housed in confined, windowless quarters, the simulator is lighted solely by a projection of the earth's surface as it will probably appear from 100 miles up. Initial contact with this beast is rather awe-inspiring.

Imagine then my feeling when I was invited to ride the monster. To the obvious delight of my guide and the beast's "keeper," I was pushed, which seems to be a better verb than helped, aboard this maze of tubes and girders, and settled my trembling body on the pilot's couch.

I've dabbled previously in psychology so the need for a couch in conjunction with this diabolical contraption was not too surprising. Inevitably, of course, they strap you in. This, it was explained to me, was simply a precaution to keep you from falling on your head. The very fact that I had consented, I think, to enter the thing should have convinced everyone that such an eventuality could hardly damage that portion of my anatomy.

Once "tied" in place, a complicated explanation of the side-arm, three-axis controller follows. Truly a further example of the ends to which the scientific mind may range, this unit is designed to fly this glorified torture rack. Without rudders, this stick has been designed to incorporate their action as well. Additionally, only pitch reacts in a normal manner. Yaw and roll are opposite to aircraft reaction and also diametrically opposed to these planes in what we accept as normal flying attitudes. In short, past pilotage experience is an early hindrance.

With the machine balanced, and obviously satisfied I was thoroughly confused, my torturers cut in the air on which the bearing rides. The resultant noise and reaction must certainly parallel the launch of an *Atlas*.

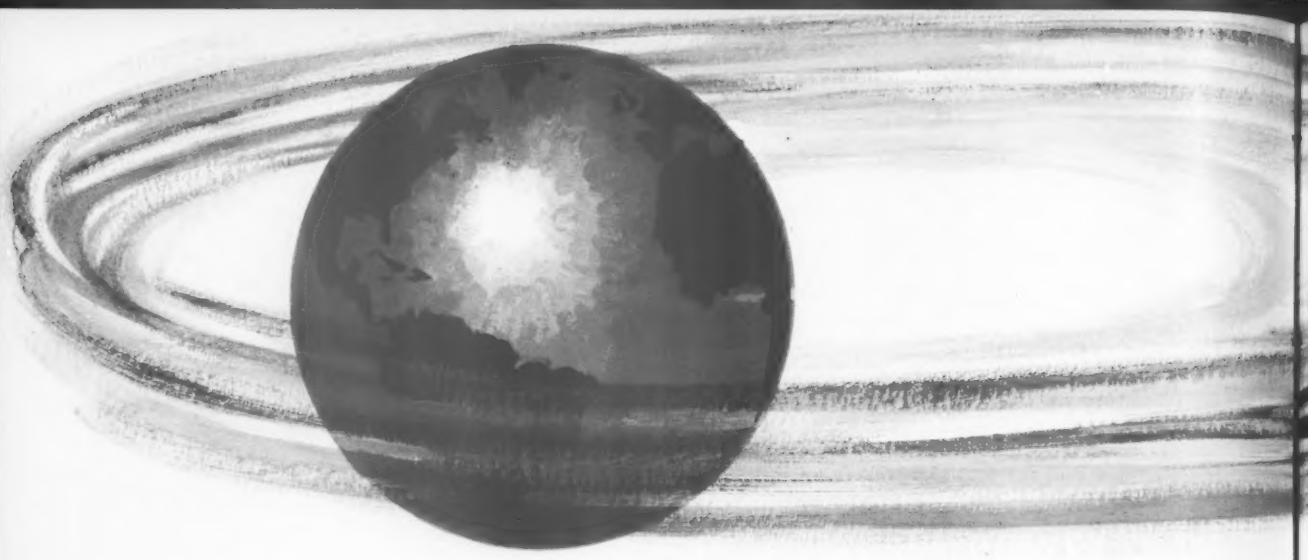
Recovering sufficiently from the initial shock, I eventually began to "orient" myself and was surprised to note that directly between my up-tilted feet, the Puget Sound area was slowly passing beneath me. Convinced that I was now in complete control, I began fiddling with the controller which was deceptively quiet in my right hand. It immediately reacted as if alive—and to the best of my recollection, that was the last time I saw earth.

As air-jets hissed hideously and my guide and the keeper chuckled fiendishly between ill-disguised stage-whisper comments on the capsule's attitude, I struggled to bring my vehicle back into balance.

Each correction produced only further confusion. What few glimpses I did manage to catch of the elusive earth were usually from a position directly akin to upside down.

Apparently convinced that my confusion was complete and struggling manfully to recover from convulsive laughter, the instructor duo decided it was time to return me to earth. With a rush of air that was infinitely worse than that which accompanied blast-off, the gyrating capsule settled back into a firmness which only steel and concrete can produce. The realism of my flight was heightened by the sweat which trickled into my eyes and soaked my shirt.

I still maintain that unquestionably this latter phenomenon was the result of re-entry heating, despite the fact this initial claim was greeted with knowing nods by all to whom I advanced it. At any rate, the seven original volunteers are safe—I'll not fight for the right to be first into space. —HAL BAMFORD



THIS I

by SMSgt. Edison T. Blair, *Airman Staff*

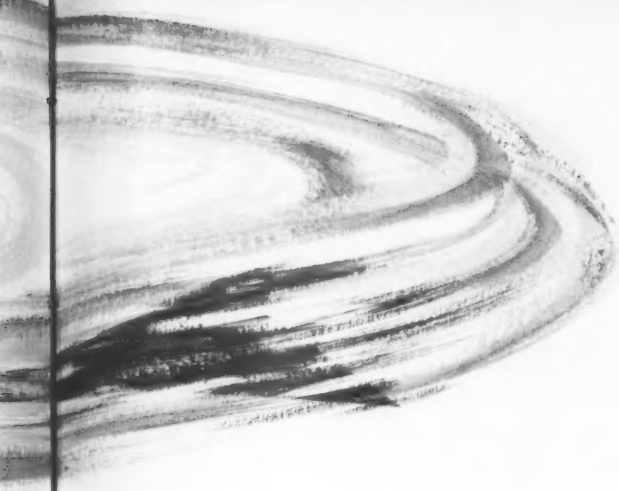
BEHIND carefully locked doors deep within the well-guarded Boeing Airplane Company plant in Seattle, Wash., squats a weird black shape. It is a shape that has been growing and forming in the minds of scientists, engineers, and military strategists for 20 years. It may help determine our whole future. The black monster is a full-scale mockup of the mysterious *Dyna-Soar*, a manned, boost-glide space vehicle.

Dyna-Soar is neither missile, airplane, nor satellite but it will have distinguishing characteristics of all three. At first, a *Titan* ICBM booster will propel it great distances at ballistic missile velocities just short of orbital speed. Later, bigger boosters will thrust it into orbit and *Dyna-Soar* will become a short-term satellite. When the man inside decides to go home, he will pilot it back through the atmosphere to a base of his choice just as he would an aircraft. Like an aircraft, it will need only routine repair and maintenance before the next flight into space.

The name of this aerospace craft is an abbreviation of dynamic soaring, a term that describes the aerodynamic principles of its operation. These principles are thrust, lift and drag. Every small boy that has skipped a flat stone across a millpond or tossed a paper dart across a schoolroom has used these principles. The principles were first harnessed successfully by the Wright Brothers when they hung an engine providing continuous thrust onto a glider-like framework.

Dyna-Soar will use the principles differently. The booster's thrust will hurl the weight of *Dyna-Soar* against the string of the earth's gravity to create centrifugal force and achieve altitude. Thus the craft acquires a store of energy—the kinetic energy of its motion and the potential energy of its altitude.

The pilot manages this energy; trades altitude for speed and distance that enables him to skip the aerodynamic shape through the atmosphere



S IS DYNA-SOAR

Dyna-Soar *is a manned aerospace vehicle being created by science and technology from old principles and desires to cross the threshold of space.*

like the boy skipping the stone across the pond. The difference is in the control surfaces of *Dyna-Soar* that make it fully maneuverable throughout the flight. Like the Wright *Flyer, Dyna-Soar* will lift man across a new threshold. Aircraft have helped man to probe the most remote corners of the earth. Who knows to what corners of the universe aerospace craft will take him?

Building Blocks

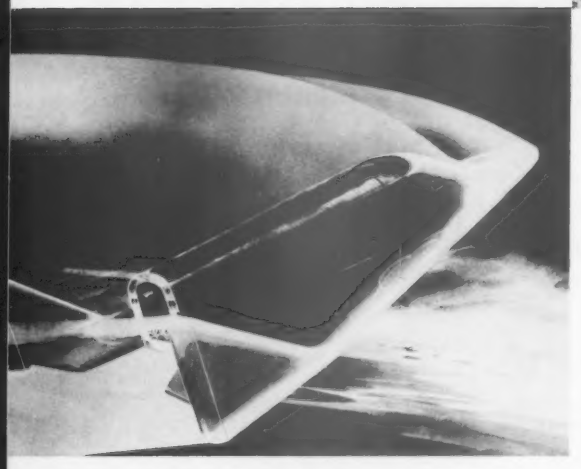
On page 4 of THE AIRMAN you may read of the *Project Mercury* astronauts who will sample the effects of weightlessness and study man's capabilities in a space environment while they orbit the earth. They will have little control over the flight path of their capsule that will return them to earth by parachute.

There's also the story of the X-15 designed to help man explore the borders of the atmosphere 100 miles up at speeds approaching 4,000 miles per hour. The stubby steel wings and nose of this research plane will glow red hot from air friction—up to 1,200 degrees Fahrenheit—as the pilot maneuvers it back through the dense atmosphere.

The scientific knowledge and technical data collected in these two programs will define new flight corridors to space, corridors whose limiting walls are built of shock waves, G-forces, aerodynamic heating, and human frailties. *Dyna-Soar* will further research these corridors until man can enter space and return to earth at will.

This exploration demands a vehicle with a speed more than four times greater than that of the X-15 and able to withstand reentry temperatures three times as great without structural or material damage. So while the aerodynamic principles are simple and well understood, many design problems must still be solved.

A tribute to the engineers who solved the problems of aerodynamic stress and heat, Dyna-Soar *will be built of materials currently available.*



Artist shows D/S, heated by reentry, skip gliding through earth's atmosphere exploring regimes of flight never before experienced by man.

From wind-tunnel test plans and specifications, model designers make detailed drawings of model configurations . . .

Growth Potential

The entire *Dyna-Soar* program is under technical control of the Air Force with the advice and assistance of the National Aeronautics and Space Administration. Air Force is financing the design, construction, and test operation. A NASA officer is chairman of a technical team concerned with research instrumentation and data acquisition. Boeing will develop and build the unpowered glider vehicle. The Martin Company will modify its *Titan* ICBM to provide the booster.

Although it will be a hypersonic aerospace craft for military research, the ultimate use of *Dyna-Soar* will be based on its growth potential. This is in keeping with our national policy of utilizing space for peaceful purposes. A later development of such a vehicle might be used to ferry men, supplies, and scientific equipment to a manned satellite. A *Dyna-Soar* type of craft could be fitted with a variety of military subsystems to make it a defensive, offensive, or reconnaissance weapon system. It has been pointed out by Lt. Gen. Bernard A. Schriever that a later *Dyna-Soar* system might be developed to intercept, inspect, board, disable and possibly destroy hostile satellites.

"But the real value of *Dyna-Soar* must be seen in the light of the long-term central requirement of establishing man in a space environment," General Thomas S. Power, CINCSAC, wrote General White in 1957. At about the same time General White stated publicly that we must be able to operate not only in the atmosphere but in the space beyond as well.

History

Possible military applications of a skip-glide bomber were considered by the German High Command during WW II. Dr. Eugen Sanger proposed development of a rocket-powered bomber launched from a two-mile-long track that would attain hypersonic speeds, leave the atmosphere, and glide halfway around the earth after reentry. The project was scrapped for lack of time, money, materials and engineering skills.

But Sanger's top-secret recommendation reached Drs. Wernher von Braun and Walter Dornberger who were working on the V-1 and V-2 programs at Peenemunde. Dr. Dornberger continued research on the idea and proposed his version of a hypersonic glide bomber to the USAF after he came to this country.

Bell Aircraft Corporation, where Dornberger is now a vice president, was given a contract by USAF in 1954 for a limited study of boost-glide systems. The National Advisory Committee on Aeronautics (NACA), predecessor to NASA, encouraged the research. The Air

Research and Development Command sponsored several other studies in the area by contract with Boeing, Convair, North American Aviation, and Republic Aircraft. These studies were finally combined into a single plan that was accepted by the Air Force as the present *Dyna-Soar* program in late 1957.

The program was organized in three overlapping phases in order to gain the most practical experience and technological knowledge with lowest risk and minimum cost. Any and all technical information in aerodynamics, structures and materials at hypersonic speeds is useful in design, production and refinement of advanced systems. The program will progress step by step as technology advances. Boeing and Martin of the seven bidders won development contracts. Both are making any knowledge gained in research available to others in the industry.

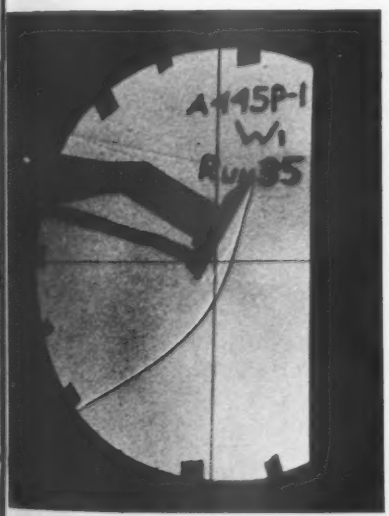
Despite the long period of study, the program has begun in a relative vacuum of information. There are theories aplenty, but they are not all proven. Wind-tunnel, heating, and model tests have to be planned and made to confirm theories and indicate that solutions to design problems are probable. Although the feasibility studies have been completed, Boeing still has more than 10,000 hours of in-place wind-tunnel work before the final design configuration is produced. A vehicle capable of operating in both the vacuum of space and the earth's atmosphere has never been built before so theories can be verified only by experiment.

"We know that we can build the machine now," George H. Stoner, *Dyna-Soar* project manager for Boeing, told THE AIRMAN. "Of course, we still have some technical problems to clear up, but we have no real roadblocks in our way."

A former national champion model builder whose hobby became a job, forms Dyna-Soar tunnel test shapes to tolerances within two thousandths of an inch . . .

The Air Force manager, Col. W. L. Moore, Jr., who heads a new concept of ARDC's Weapon System Project Office at Wright-Patterson AFB, agrees that no major breakthroughs are needed. This new WSPO, which puts more emphasis on Air Force management, is supported by a directorate of Systems Engineering and a directorate of Advanced System Technology as well as performing the usual System Management functions. Col William Davis, representing the Air Materiel Command side of the WSPO, has his office adjacent so that coordination between management, procurement and engineering is simplified.

This new super organization, Colonel Moore said, permits the entire complex of Wright Air Development Division with its storehouse of applied research knowledge and engineering capability to be applied directly to any problems that arise in the *Dyna-Soar* program.



In tunnel, aerodynamic shape plus hypersonic winds give visible shock-wave information to technicians.

Problem Solutions

Thrust has been the keystone of every advance in aeronautics. Men experimented unsuccessfully with aerodynamic lifting devices for a thousand years before the Wrights solved the problem with an engine on their *Flyer*. Since then aircraft design and efficiency have kept pace with better engines and greater thrust. The rapid advance in rocketry in missile development has now produced engines with enough thrust to put man into space. But solution to the thrust problem has given birth to a new generation of problems, notably that of aerodynamic heating.

Orbital velocities pose no problem in space, but during reentry, friction with air molecules generates tremendous heat quickly. One of the biggest problems faced by designers of *Dyna-Soar* was finding or creating materials and structures that would survive this heat. Most satellites that have reentered the atmosphere were destroyed by frictional heat. Missile nose-cone reentries were partly solved by using ablative material that is destroyed through a vaporization process that dissipates heat. The remainder of the solution was found in the blunt shape of the nose cone. The bluntness produces an insulating shock wave that blocks much of the frictional heat.

Boeing engineers tested everything from ceramics to graphite compounds to temperature-resistant metals to find materials best suited for

Dyna-Soar. The shape was even more important here. *Dyna-Soar*, so the objectives stated, was to have "sufficient maneuverability to make return from orbit a routine, nonadventurous, supportable, day-to-day test or military operation." That meant movable control surfaces on a winged reentry vehicle with certain airflow characteristics. This in turn produced structural design problems.

Despite the fact that *Dyna-Soar* hasn't been off the ground yet, Boeing officials claim that it has survived seven or more reentries. In the course of their materials and structures testing, full-scale portions of the *Dyna-Soar* skin and underlying support structure were stressed with loads comparable to those it would be expected to sustain during reentry.

Huge radiant heat lamps were clustered close to the skin and connected to the company's 5,750 KVA power supply. The resulting heat was so intense that the wiring to the lamps burst into flame several times while the model was heated up to 2,000 degrees Fahrenheit. Manganese steel melts at 2,750 degrees; practically everything melts at 3,000 degrees C. The *Dyna-Soar* model, built of materials currently available, suffered no structural or material damage during these tests that simulated various maneuvers during reentry. Boeing engineers, Stoner said, have solved the structural barrier and opened the door to space flight.

Other data, recorded electronically in 90-second runs, accumulates for hours to prove or disprove aerodynamic theory . . .

Data Bits

As aircraft speeds have increased with improved thrust, aerodynamic shapes have changed accordingly. Today's delta-winged Convair F-106 bears little resemblance to the Wright Flyer yet it uses the same three principles of thrust, lift and drag. The F-106 recently set a new world's speed record for manned aircraft of 1,520.9 miles per hour, but this is only one-twelfth orbital speed. To date man has had little experience with hypersonic speeds that may go up to Mach 30. Such speeds can now be achieved for only split seconds in a few wind tunnels.

By piling up thousands of these split-second tests on scale models engineers can accumulate the knowledge needed to design aerodynamic shapes stable enough to be trusted with a man's life. Some wind-tunnel data are even preliminary to preliminary design. The short stubby wings of the X-15 that perform perfectly at 4,000 miles per hour are totally inadequate at 18,000 miles per hour. Wind-tunnel data give engineers the information they need on sweep angle, cross-sectional profile, length, thickness, and leading edge radius of a wing.

The chief of Boeing wind-tunnel facilities, John H. Russell, has been with the company more than 20 years. He has seen a lot of airplane shapes hatched in the big wind machines.

"Sometimes the design engineers come to us with ideas only," he told us. "We get the basic information they need to evaluate their ideas. We find out what happens to various shapes at varying speeds and altitudes, then help them integrate one bit of information against another.

"We did over 10,000 hours of wind-tunnel research on the B-52. Until *Dyna-Soar,* that's the most effort we've put on any vehicle. But *Dyna-Soar* covers a much greater speed regime. Then, there's reentry heating. So, you can see that wind-tunnel tests are going to take a big chunk of that development money."

Some of the materials considered for *Dyna-Soar* construction were cinderized when subjected to Mach 15-20 winds in the tunnel. Others disintegrated completely in a matter of seconds. Some succumbed to sonic fatigue and acoustical vibration. Wind-tunnel tests provide data on performance and stability of various shapes and their structural loading and heating characteristics.

Another very important problem for wind-tunnel solution is a new one—that of decomposition and recombination of gases. At *Dyna-Soar* velocities, the shock wave on the nose and leading edge of the wing generates enough heat that air molecules break down into the ions of the gases that make up the atmosphere. As of now no one knows exactly what the aerodynamic properties of these ionized gases are. Will they produce the same aerodynamic forces on control surfaces? What will be the chemical and physical reactions on the materials in *Dyna-Soar?* What will be their effects on lift and drag as we presently understand these principles? These questions must be answered in the coming months of research and development.

Something is known about the effects of this ionization on communications systems. General Electric's Missile and Space Department technicians have reported that shock wave induced ionization at certain altitudes detunes communication antennae, absorbs some of the signal strength and reflects other signals at the point where the plasma—ionized gas, a fourth state of matter in which nuclear protons are separated from the neutrons—joins free space.

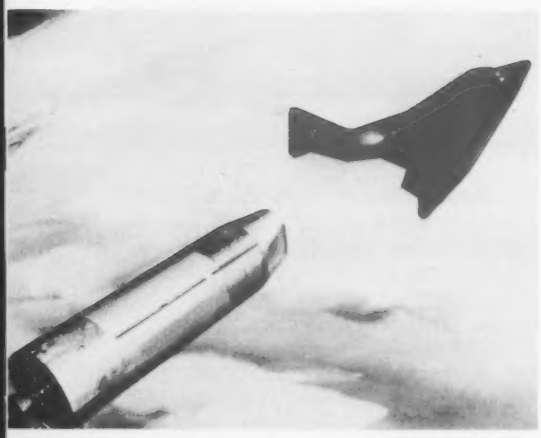
These reports were based on powered reentry flights of a heavily instrumented *Atlas* missile. The electronic experts surmised that the signal fading was caused by a combination of the effects of shock wave-induced ionization and an electric field surrounding the antenna. Communication engineers must be aware of this phenomenon when designing equipment. This emphasized how the solution of one problem—in this case reentry—creates new problems that demand technical knowledge from every scientific discipline.

When data is correlated, systematic errors mean theory is wrong. Random errors prove Murphy's Law—anything that can go wrong, will go wrong.

ject Manager Stoner tells the Air Force t another firm step toward an operational ospace craft has just been accomplished.

Harnessed Power

The booster engines for *Dyna-Soar* will not be just shelf items off the Martin assembly line nor will modification of stock missiles disrupt the ICBM program. The expensive tooling already in place at Martin's Denver plant will be used in the modification. The biggest change in the appearance of the *Titan* will be the addition of fins to counteract the aerodynamic forces exerted by the winged glider that replaces the sleek



After booster burns out, D/S pilot will blast his space vehicle free of the dead rocket and trade the potential energy of altitude for the kinetic energy of speed to return to the base of his choice.

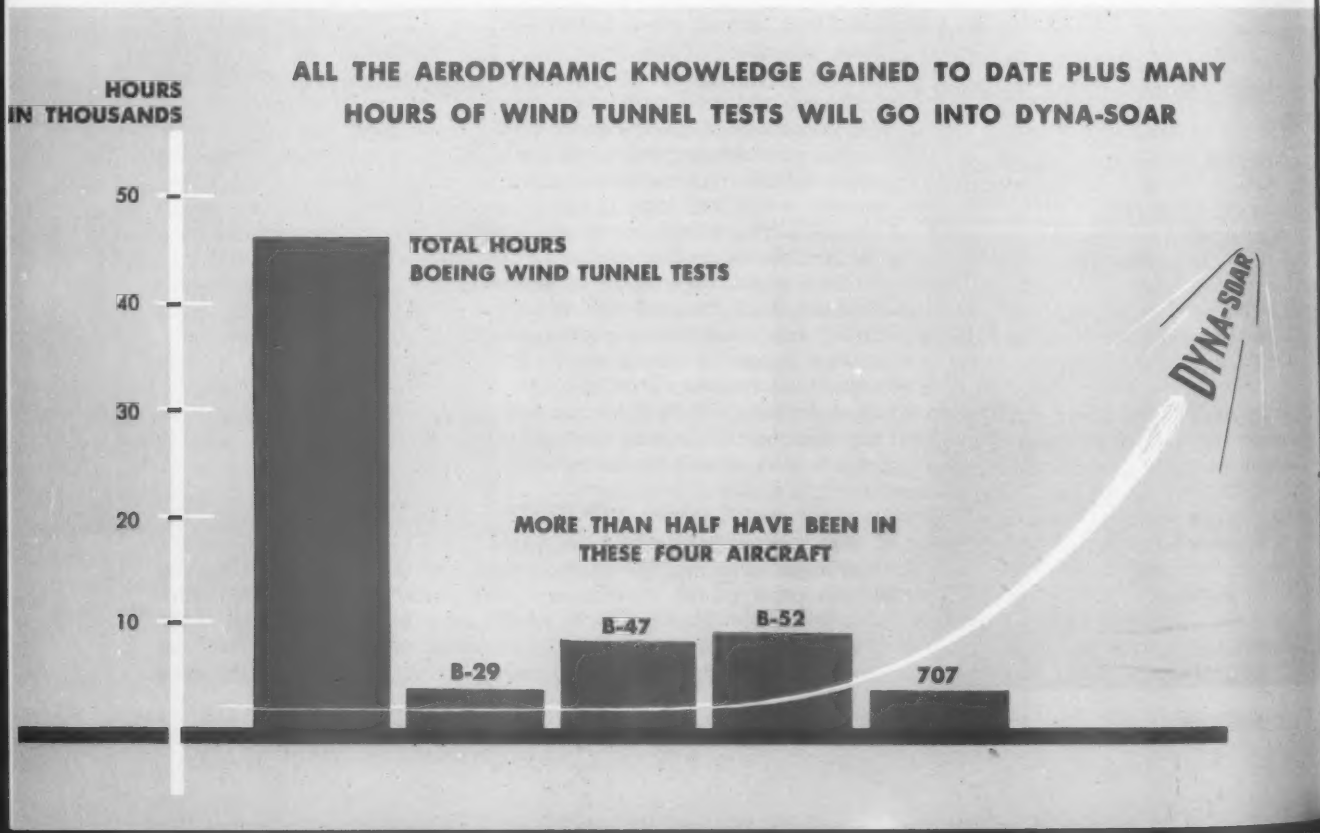
nose cone. The shell and supporting structure of the booster will also be strengthened to withstand the greater stress of added air resistance and a more shallow trajectory.

Booster procurement and management will be under ARDC's Ballistic Missile Division at Los Angeles. Project officer is Maj. Gail Halverson of BMD's Manned Research Projects directorate. His job: "fill a cube in space with that glider." Like Colonel Moore, the major will have at hand all of the Air Force's experience in ballistic missiles plus the highly specialized support of the Space Technology Laboratories.

There will be a man aboard *Dyna-Soar* so safety and reliability will be paramount in the planning. The men in BMD who will perform the marriage of the booster to the glider are fully aware of the pilot's point of view. They are ex-test pilots with engineering degrees. They have already demonstrated that they have a feel for experimental systems gained through personal experience.

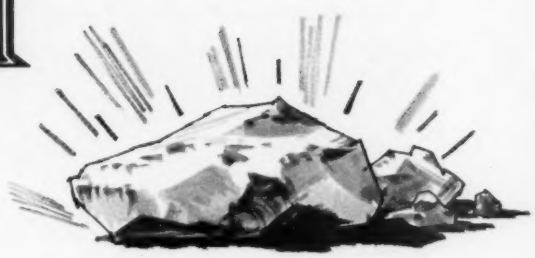
All the human-factor knowledge and experience available from all prior systems will be built into the *Dyna-Soar* cockpit configuration. The side stick controls being tested in X-15 and *Project Mercury* will be there with any improvements made. Normal flight and attitude instruments will be grouped on the right—control stick—side of the panel. Emergency instruments and warning lights will be on the left side, as will be the "chicken switch" that makes the pilot boss throughout the mission. Observation windows will flank the pilot. In front of him will be a window covered against the heat until an instrument tells him he can "Look," then the cover is jettisoned so he can see to make a conventional landing.

Man's history is the eons-long story of his struggle upward from the primordial mud of Creation toward the vastness of space and the sun which is the source of energy for his planet. He now stands on the very threshold of space at the top of a technological stairway the scientific blocks of which were hewn from the secrets of the universe by the sharp edge of his curiosity. *Dyna-Soar* will carry him across this threshold closer to the secret of peace and security.



TITANIUM

METAL WITH A FUTURE



A Cinderella metal is staking a claim to special usefulness for space purposes. The second or protective inner hull of the *Project Mercury* capsules is constructed of titanium, a metal that waited over a century and a half for its industrial debut. It has also been tested in successful firings recently as the complete casing for the third stage rocket motor of the *Minuteman.*

On paper titanium always has had two important qualities to recommend it for use in space devices—its high strength and relatively light weight. However, the technological problems involved in refining the metal from various ores, and processing it for fabrication, long were the big question marks about the feasibility and economy of its eventual use.

A little over a dozen years ago, reference works were setting down titanium as a metal with limited known usefulness and virtually confined to research and experimental purposes. It was not until 1948 that titanium was first produced commercially in the U. S. in sponge and ingot form with a purity of 99.5 percent. The price came high then, $5 a pound.

No. 22 element on the Atomic Table, titanium was discovered in 1789 by a British clergyman, the Rev. William Gregor, in a black sand peculiar to an area in Cornwall, called Menachan. He named the titanium portion of the compound menachite. Evidently news of the discovery received limited circulation, for some five years later "rediscovery" of the element was credited to a German chemist, Martin Klaproth, who identified it as an ingredient of the reddish ore, rutile, which he was investigating.

It was Klaproth who gave it its present name. Finding it exceedingly difficult to separate from the other component of the ore, he was reminded of the mythological Sons of the Earth—*Titanes,* in the ancient Greek—who clung so stubbornly to the soil, and called it after them for that reason.

Despite continuing laboratory efforts, more than a century passed before a research worker succeeded in isolating a 100 percent pure quantity of titanium in 1910. It is a silver-white, lustrous metal in its pure state, brittle when cold and may be powdered. It has a melting point of about 1,800 degrees Centigrade (3,272 degrees Fahrenheit) and a boiling point of more than 3,000 degrees C. (5,432 degrees F.). These temperatures are comparable to iron with 1,535 and 3,000 degrees C. respectively. Titanium is almost as immune to rust as platinum.

Geologists have now established that titanium is the ninth most abundant element by weight to be found in the earth's crust, being topped in the following order by oxygen, silicon, aluminum, iron, calcium, sodium, potassium, and magnesium. In distribution, too, titanium is more abundant than some other metals. For example, it averages some 60 times more in weight per ton of the earth's crust than copper and 30 times more than zinc. The trouble is that titanium is very active chemically and forms numerous compounds; hence it is more widely distributed than metals to be found concentrated in veins of various quality ores.

The chief sources of titanium are rutile, the native dioxide ore, and ilmenite, which also contains iron and oxygen. Substantial reserves of both ores exist in the U. S., as well as in Canada, Australia, Brazil, Scandinavia, and elsewhere in the Free World.

Since industrial production of titanium began a dozen years ago, it has found wide use in compressor blades, turbine discs, and many other jet components because the metal is resistant to high temperatures and is also weight saving. As an alloy, it has found increasing use in airframe parts, again because of the favorable weight and strength factors.

The element can add hardness and tensile strength to steel alloys, or in "scavenger" compounds remove impurities from steel, brass, and bronze during the manufacturing process. In various forms, titanium supplies pigments for paints, mordants for processing fabrics or leather, and material for electric arc electrodes.

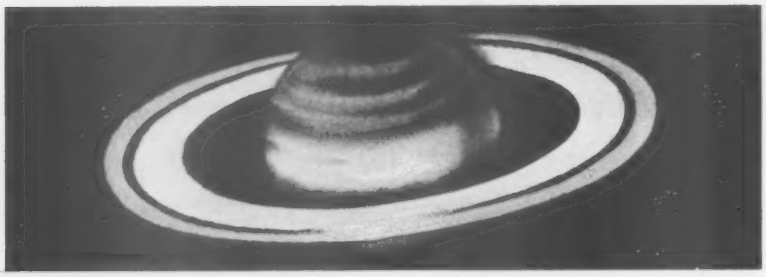
Currently, the National Bureau of Standards has under way an extensive research study of titanium from the point of view of extreme stresses, temperatures, and other abnormal conditions which might beset a space vehicle.

The experimental titanium third-stage test fired for the *Minuteman* was some 30 percent lighter than previous such stages made of steel and could be lifted by two men. The lighter weight would make possible a significant gain in the ICBM's range capability.

In the weight-saving competition, titanium is outdone, however, by a sample third stage made of plastic reinforced with Fiberglas. Yet the plastic casing has a definite liability: exposure to moisture tends to distort its configuration, and this may pose a significant consideration for its use on missiles to be stored in underground silos over extended periods.

—WILLIAM A. KINNEY

SLANTS ON SPACE



STRANGE SPLENDOR OF SATURN'S RINGS

Saturn's unique rings glow with strange splendor in the vastness of space. Their beauty inspires usually restrained scientists to employ such adjectives as splendid, magnificent, and exquisite. One astronomer wrote: "The superb ring system which surrounds the yellow, flattened disk of the planet is alone in its glory; its fascination never palls."

Two naval astronomers went so far recently as to speculate that man, theoretically, could place a Saturnian ring of bright metallic dust around the earth. This suggestion was not esthetic but practical. For better or worse, reflection from the particles would create perpetual light on this planet.

Billions of Fragments

The rings of Saturn are composed of countless billions of tiny fragments whirling rapidly around the planet. They probably range in size from dust to lumps the size of golf balls. Once thought to be rock, the particles now are believed to be ice or perhaps stones covered with ice.

Origin of the miniature satellites is not known. One theory explains the rings as debris of one or more moons shattered by the pull of Saturn; another holds that the rings were formed directly from indigenous matter surrounding the planet.

Astronomers regard the rings, which are concentric, as the thinnest objects for their size in the solar system. Though they measure 170,000 miles from rim to rim, each ring is only 10 miles or so thick.

There are three principal rings. The outermost band, grayish-white, is about 10,000 miles wide; the brilliant-white middle ring, 16,000 miles; the dim, blue-gray inner circle, some 11,000 miles. A wide gap of 9,000 miles separates the innermost ring from Saturn.

The rings lie exactly in the plane of Saturn's equator, which is inclined about 27 degrees to the earth's orbit. An astronomer usually is looking at the rings from an angle, thus he can see them clearly.

Rings Virtually Disappear

Twice in Saturn's 29½-year journey around the sun, however, the rings turn edgewise toward the earth. They disappear then from the view of small telescopes and appear as a thin line in large instruments.

The transitory quality of the rings made Saturn the despair of early observers. Galileo thought he detected two globes flanking the planet in 1610, and wrote his finding in an anagram. Unscrambled, it read, "I have observed the farthest planet triple." When the supposed globes gradually disappeared, he suspected he had been misled by an illusion.

Huygens, the Dutch astronomer, solved the problem in 1655 with his famous anagram: "It is girdled by a thin flat ring, nowhere touching, inclined to the ecliptic."

Galileo and Huygens, like other scientists in the day before copyright laws, often announced their discoveries in anagram form. This secrecy established a finding, yet gave them more time for research and checking.

PUZZLE OF PLUTO

Pluto remains a puzzle to astronomers 30 years after its discovery.

Is the remote planet a runaway satellite? What is its diameter and mass? Is it many times denser than the earth?

Pluto, incredibly frigid, dark, and barren, is the ninth and most distant known planet in the solar system. It is 3,666,000,000 miles from the sun and requires almost 248 years to complete an orbit.

Dr. Gerard P. Kuiper of Yerkes Observatory, Williams Bay, Wisconsin, believes Pluto is a moon that escaped from Neptune. He theorizes that three satellites originally revolved around Neptune. Gradually as the huge planet lost much of its original mass, its gravitational grip grew weaker. The satellites swung farther and farther from Neptune and eventually went their own way. Two were recaptured when they came close to the planet again, but Pluto remained free.

Egg-Shaped Orbit

To support his theory, Dr. Kuiper points out that Pluto rotates only once in 6½ days, and makes a highly eccentric journey around the sun. The egg-shaped orbit is canted at an angle of 17 degrees and periodically cuts across Neptune's path. The two bodies miss colliding by a comfortable 240,000,000 miles. From 1969 to 2009, Pluto actually will come closer to the sun than Neptune.

Visual observations through the 200-inch telescope at Palomar Observatory made in 1950 indicate that Pluto's diameter is only 3,600 miles, less than half that of the earth. Previously, Pluto was thought to have roughly the same mass and diameter as earth because of its effect on the orbits of Neptune and Uranus.

If Pluto has a diameter of only 3,600 miles, it must be 10 times as dense as earth in order to have the mass necessary to disturb the orbits of Neptune and Uranus. Such an

enormous density—five times that of lead—is considered unlikely. Some astronomers believe Pluto's density is normal and its mass only about three per cent of earth's. They say the orbital perturbations were incorrectly measured.

However, both W. H. Pickering of the Harvard Observatory and Dr. Percival Lowell, founder of Lowell Observatory, Flagstaff, Arizona, predicted the region where Pluto would be found on the basis of its disturbances of the orbits.

White Patch on Planet

Some scientists argue that it is too much of a coincidence that two eminent mathematicians could obtain independent, accurate results from erroneous data. They speculate that Pluto has a mottled surface and measurements of it cover only a large white patch, not the whole planet. This would make it large enough to perturb other planetary orbits.

Dr. Lowell died before he could complete his search for the predicted planet. In 1929, Clyde Tombaugh, a 24-year-old astronomer, joined the celestial hunt for Planet X at Lowell Observatory, where he was to scan 90,000,000 star images. He methodically photographed the same area of the sky several days apart.

Professor Tombaugh, now of Las Cruces, New Mexico, slipped twin photographs of a sky segment into a "blink" microscope on February 18, 1930. The apparatus quickly imposes one picture on another. As he watched, fixed stars remained in position. But an image no larger than a pencil's dot appeared to jump back and forth. It was Planet X, later named Pluto.

Ironically, examination of plates taken earlier by both Lowell and Pickering showed that they had captured weak images of Pluto, too faint to be recognized at the time.

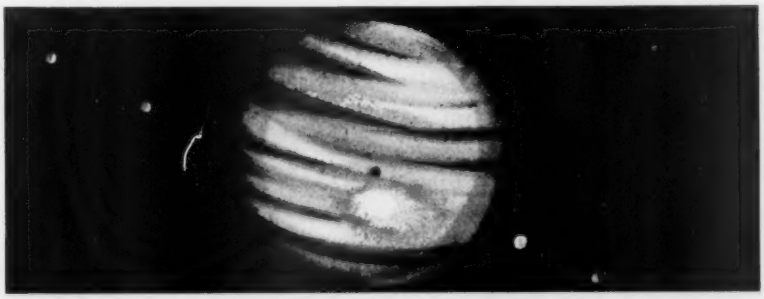
Courtesy NATIONAL GEOGRAPHIC SOCIETY

MYSTERIOUS RED SPOT OF JUPITER

One of the most tantalizing mysteries in the Solar System is the Great Red Spot of Jupiter. This unusual feature, first observed almost three centuries ago, is oval in shape, with a length of some 30,000 miles and a maximum width of about 7,000 miles.

Following its discovery in 1665, sightings of the Great Red Spot were reported only at considerable intervals until astronomers took it under systematic study in 1878. The conclusion from observations since then is that the feature is a permanent phenomenon. For its erratic behavior, however, there is no generally accepted explanation.

One early surmise was that the red spot might be a portion of Jupiter's surface seen through a clearing area in the giant planet's cloudy atmosphere. Another hypothesis suggested was that it might be a tinted blanket of haze or smoke hovering over an active volcano. Such notions went by the board when studies established that the location of the spot was not permanent—it had a longitudinal drift. In one three-year period, for instance, it moved about 44,000 miles, a distance fairly close to the equivalent of two trips around our world.



Like its position, the red spot's color and visibility also are subject to great variations. At its brightest (as when regular studies started in 1878) it has a striking brick-red appearance and can be easily seen even with a small telescope. When it fades its outline becomes so faint as to be hardly visible and all the rosy hue drains away, leaving the color a milky green.

The spot does its drifting below Jupiter's equator in a belt comparable to the South Temperate Zone on our globe. Immediately beneath this belt the planet has a normally dark section, measuring some 45,000 miles in length and called the South Tropical Disturbance. This seems to have some relation to the spot's behavior. Periodically the darkness of the disturbance lightens and when this happens, the red spot's striking color deepens. The disturbance also rotates more rapidly than the spot. Whenever it overtakes this mysterious feature, there is evidence of a violent interaction and then the disturbance drags the spot along at greater than the latter's normal rate of movement until the two phenomena unaccountably separate and float apart again.

Jupiter has numerous markings but all but a few are transitory, lasting a matter of weeks, only rarely for months. In outline they are continually changing and it has been suggested they may be shifting cloud formations in the planet's atmosphere. Since systematized studies of the Great Red Spot began in 1878, however, this feature has maintained an apparently relative stability never observed before in any atmospheric formation over such an extended period of time.

What can the Great Red Spot be composed of? When telescopic instruments can be carried aloft in a space vehicle to study this formation in the full spectrum of solar light, astronomy may begin to learn the nature of the long elusive answer.

CONVALESCENT LEAVE

When there are new fields to conquer and unknown paths to explore, it's natural that airmen try to be first . . . even if they have to get out of hospital beds to do it.

by TSgt. Harold L. Craven

HOSPITAL LIFE might have been less wretched for Lieutenant Gish if he hadn't felt so keenly about the need for maintaining a strong peacetime Air Service. Outside his antiseptic environment flyers were preparing for a transcontinental reliability and endurance race, a test of machines and equipment that could result in greater civilian support of the Air Service. Gish wanted to fly one of the planes.

The lieutenant was one of the Army's most experienced pilots. He had learned to fly at College Park, Md., in 1911, and had served overseas with the First Night-Fighter Group in the great war. Now he was in a Stateside hospital recovering from war injuries. The Armistice was less than 11 months old and powerful forces were being brought to bear against military aviation.

Friends kept the hospitalized flyer posted on plans for the forthcoming mass transcontinental flight. The more he learned about it the more he wanted to be a participant. When it was officially announced that the flight would take place in October he asked for, and was given, a 30-day convalescent leave. Unmindful of the advice of fellow patients to "Take it easy. Don't aggravate your injuries," Gish went directly to New York's Roosevelt Field. Gen. Billy Mitchell congratulated him on his willingness to use his leave time for the good of the Air Service and assigned him a Liberty-powered de Havilland biplane.

The flight was begun on October 8, 1919. Lieutenant Gish and his passenger, the French Air Attaché, were the second crew to take off. Their plane seemed to be in excellent mechanical condition, but it caught fire when they were within 40 miles of Binghampton. Gish had no choice but to head for the nearest point of land, a hill top, and set the plane down as quickly as possible. The terrain was rough and the DH-4 was damaged beyond economical repair.

Gish expressed his regrets to the French Air Attaché and returned immediately to Roosevelt Field to report his failure. To his amazement he was given a new DH-4 and allowed to make a second start. This time he reached Binghampton where he was forced down by a snowstorm. During his overnight delay there he replaced a faulty propeller, then took off at dawn and headed toward Rochester.

Enroute, the plane developed an oil leak. Gish landed at Ithaca, plugged the hole with a ten-penny nail, flew on to Rochester, then Buffalo where rain and snow detained him until the following afternoon. Then by flying under the clouds at 200 feet he was able to go on to Cleveland. There he learned that several of the 44 airplanes had already come to grief. Even though most of the airplanes were ahead of him, he still considered it to be anybody's race.

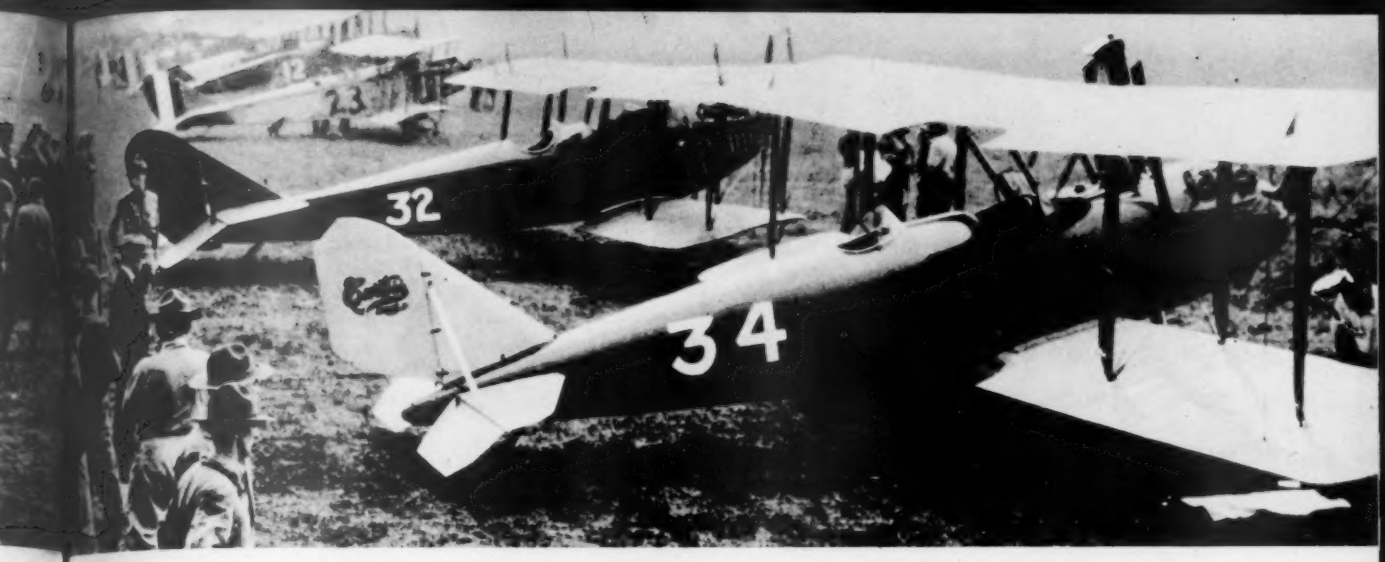
Engine repairs, replacement of tires, and soldering of a badly leaking radiator occupied the flyer's time while weather held him on the ground at Cleveland. On October 13-14 he made his way to Chicago, Rock Island, Des Moines, and Omaha.

Heavy fog held him at Omaha overnight. Then he hedgehopped to St. Paul during a period of almost zero visibility, stopped long enough to refuel and headed for North Platte. The radiator started leaking again and he returned to St. Paul.

On October 17 the weather broke and he flew to North Platte, waited there two hours until a blizzard passed, then spent the next two days flying to Reno. Mountain storms caused another night's delay, but he reached San Francisco at noon on October 20.

At San Francisco the airplane was declared unfit for further participation in the race. He waited three days for another machine, read with some envy the newspaper accounts of the exploits of Lt. B. W. Maynard, winner of the east-to-west leg of the contest, and arranged to have a mechanic, Sgt. G. C. Pomeroy, accompany him on the west-to-east flight. The new plane seemed to be in excellent mechanical condition, but the engine started missing shortly after takeoff. After a few seconds it smoothed out again and they flew nonstop to Green River, Wyoming, where they remained overnight.

On the following morning they flew to Rawlins where their landing was hampered by 35-mile crosswinds.



After being waved off three times Gish set the plane down hard. It rolled the length of the field, struck rough ground, and flipped over. The two men crawled out of the wreckage unhurt and found one broken wheel, a radiator damaged beyond repair, a splintered propeller, and two damaged wings.

"You're lucky," a local flyer told them. "The flyers who crashed ahead of you washed their planes out completely." Pomeroy made a beeline for the wreckage of the other airplanes and found enough parts to permit rebuilding of their DH-4. With the assistance of field personnel they eventually got the plane back in flying condition. The job took two days.

They departed Rawlins in a foot of snow, after closing off the bottom half of the radiator. This proved to be a mistake, for while climbing over Elk Mountain, between Rawlins and Cheyenne, the radiator and water pump froze. They descended through a blizzard and landed at Cheyenne. The plane, coated with ice, landed hard. Another few minutes in the air, Gish observed, might have meant disaster.

Weather, plus the requirement of changing propellers and soldering the radiator, held the flyers on the ground until October 27. There seemed little hope now that they could reach the east coast in the three weeks alloted for the round-trip journey. Several pilots had fared worse, however. A number of flyers had been killed or injured in crashes. Determined to complete the journey, regardless of the time required to do it, they took off at dawn, but were turned back by fog and snow. Later that day they tried again and managed to reach North Platte. They resoldered the radiator there, got a few hours of sleep, and flew to St. Paul, Omaha, and Des Moines where they remained overnight.

On the morning of October 29 Gish and Pomeroy reached Rock Island in clear weather, then encountered rain and fog enroute to Chicago. Engine failure necessitated a dead-stick landing within 25 miles of Chicago. Repairs were made and the plane was towed by horses to a field more suitable for takeoff. They waited until the morning of October 30 to fly to Chicago. There additional repairs of a major nature were necessary. Two more dead-stick landings were made at Chicago in the course of performing maintenance testing, and October 31, final day of the competition, found the DH-4 still at Chicago.

Eight pilots of the original 44 starters completed the round-trip flight in the specified time. Lt. B. W. Maynard had won the round-trip and east-west competitions; Maj. Carl Spaatz had made the west-east flight in the shortest elapsed time; and Lt. Alexander Pearson Jr. had made the round-trip flight in the least actual flying hours. Two planes completed the round trip after the final day of the race. Lieutenant Gish took first place in the "also ran" department, followed by Capt. F. Steinle, another DH-4 pilot.

Upon completion of the trip Gish returned to the hospital to continue recuperating from war injuries. The Air Service, meanwhile, started accelerating plans for a mass flight to Alaska. Despite the fact that less than 25 percent of the starters completed the Transcontinental Reliability and Endurance Race, aviation leaders considered the contest a success. *Air Service Newsletter,* in a lead editorial published following the mass flight stated:

"This great flight certainly proves that the contemplated aerial route to Alaska is not merely a dream but is very practical and can be easily accomplished.

"In covering the distance from New York to San Francisco, a distance of 2,700 miles, Lt. Maynard covered almost one-ninth the earth's circumference. In covering the round-trip distance of 5,400 miles he traveled almost one quarter of the earth's circumference. It does not seem that the time is far off when the entire circumference of the earth will have been circumnavigated by airplanes."

Less than a year later a hardy group of Air Service pilots pioneered an aerial route to Alaska. Knowledge of cross-country flying gained in the Transcontinental Reliability and Endurance Race paid off again in 1923 when Air Service aviators made the first nonstop transcontinental flight.

You should know

MISSING FINGERS

Seven men in the Air Force lost fingers last year as a result of accidents involving the wearing of rings. Four main causes are cited as contributing to this type of accident. 1. Wearing rings when working on equipment having sharp corners. 2. Jumping from an elevated location. 3. Substituting makeshift devices in place of ladders or work stands. 4. Supervisory failure to enforce safety regulations.

For those who insist on wearing rings for personal reasons, it might be a good idea to wrap the ornament with adhesive tape while working on the job.

POLIO SHOTS

Although the danger season for polio epidemics has passed for this year, the importance of proper immunization nonetheless remains. AFR 160-102 directs mandatory immunization against poliomyelitis for all military and non-military personnel who travel to an overseas area under military sponsorship.

NEW BURN TREATMENT

A new technique which may save the lives of patients being treated for severe burns is under study at the VA Hospital in Jackson, Miss. It involves injection of sky blue dye into burned areas to distinguish between partial and full-thickness burns. The test should enable doctors to determine immediately whether surgical removal of the burned tissue and grafting of new skin over the area is required. Early skin grafting (within three days after the injury) will usually prevent infection. The only deterrent has been the lack of a simple and accurate method to determine the extent of the injury.

MOSTLY FOR PARENTS

The increasing importance of education in the American socio-economic system is reflected in the Annual Report on the Progress of Education in the United States.

Americans 25 years old and over in 1959-60 had an average of 11 years of education compared to only 8.4 years in 1940-41. Approximately 30 percent of the fifth grades of the academic year 1950-51 entered college on schedule during 1959-60. Only 12 percent of the fifth graders of 1924-25 reached college.

The number of graduate degrees conferred in 1959-60 reached the all-time high of 486,400. Ninety years ago in 1869-70 only 9,372 degrees were conferred. This included one doctorate for the entire country and no master's degrees. Illiteracy in the United States has dropped from 20 percent in 1870-71 to 2.2 percent in 1959-60.

ON THE OTHER HAND

The dynamic and dramatic expansion of the American industrial machine perennially presents to young men a temptation to dispense with the time-consuming process of higher education and enter immediately into the exciting activity of the adult wage-earning world.

In the ten years ahead *seven and one half million* youngsters will drop out of school before receiving a high school diploma. A portion of this group will be girls entering early marriage, but the workers—male and female—are destined for unskilled tasks and there already exists a surplus of such workers in the economy.

Not everyone is equipped with the capacity to become a nuclear physicist or electrical engineer but the absence of talent in these obvious directions is not necessarily an indication of overall obtuseness. Despite the tremendous emphasis on technology in this generation there is still a place in the sun for the poet, the philosopher, and the artist. And the brave new world of the future could become seriously out of kilter if the system continues to produce too many "gammas."

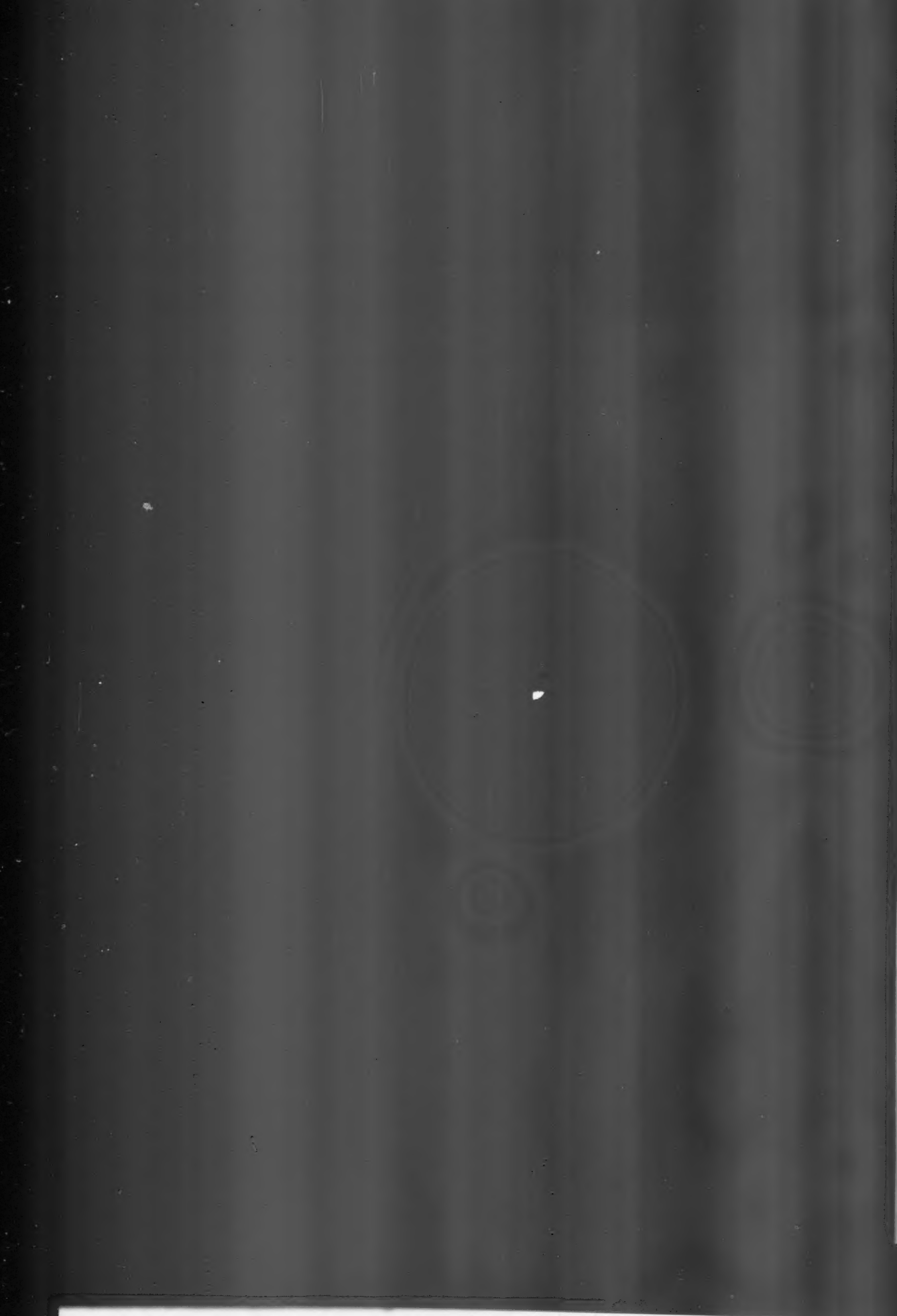
JUVENILE VIEWPOINT

In discussing the problems of higher education before the U. S. Junior Chamber of Commerce at Los Angeles, Lt. Gen. James H. Doolittle, USAF (Ret.), relayed the story of the six-year-old explaining the academic situation to his four-year-old brother. "I had no trouble in nursery school or kindergarten," said the youngster, "but I'm in the first grade now—and this higher education is murder."

HIGH COST OF ACCIDENTS

Highway accidents cost American motorists an average of $93 per car per year. More than 370,000 persons have been killed in traffic accidents in the U. S. during the past ten years. This contrasts with 301,557 Americans who lost their lives in World War II. In 1946 Americans owned 34½ million vehicles. At present the count is 71½ million. By 1976 it is estimated that there will be 114 million motor vehicles on the road.

—TSgt. JOHN K. O'DOHERTY



LETTERS TO THE EDITOR, *continued*

Never Argue with a Sage

Sir: On page 29 of the July issue you state that the PADS DATA LINK is the first military newspaper published by a SAGE Sector Headquarters. Actually, the first was the HOTLINE of the Washington Air Defense Sector, first published October 29, 1958.

Lt. Myron Wyman
Fort Lee, Va.

• *The lieutenant is obviously correct. Our source of information on* PADS DATA LINK *first publication date didn't know about the* HOTLINE.

★ ★ ★

Bombs Away

Sir: In reading the letters column in the July 1960 issue, I read with interest the letter by A2C William Wells concerning the disposal procedures for a 250 pound practice bomb. While I do not consider the use of 7½ pounds of C-3 necessary in most cases for this type of job, the EOD man was probably using the amount he felt necessary for the individual case to avoid having to re-do the shot. In cases where the range will withstand the detonation of the amount of explosive involved, the standard practice is to use enough to insure complete detonation of all explosives. When complete detonation does not occur, the remaining explosive (even black powder) is in a highly sensitive condition. I don't know if Airman Wells is in EOD or not, but in case he isn't I would like to point out that it is not pleasant to walk up on an unknown quantity of explosives in an unknown condition to pick up the pieces.

Lt. John Morris
Seymour Johnson AFB, N. C.

• *We'll buy that!*

The Other Side of the Story

Sir: Your recent MOH article on Colonel Howard and the letter to the editor in your June 1960 issue brought back memories. I, too, was a member of the 351st Bomb Gp., being in the 511th *Ball* Squadron. (All our squadron aircraft had *ball* as part of their names; *Slowball, Cannonball, Linda Ball,* etc.) On one mission my crew was flying the lead of the low squadron of the high group of the wing.

We estimated more than 100 German fighters attacked our formation.

In the hottest part of the fight, a gunner hollered over the intercom that one of the aircraft flying around us was a P-51! Then we all saw it, flying through our formations. Each time he was on the tail of a Jerry—and he got him! Upon our return to base at Polebrook, we reported the lone P-51 and what he had done. Reports from other groups corroborated our story. I believe that if you could find the issues of Stars & Stripes for a few weeks after Jan. 11, 1944, you would find the accounts about the "P-51 pilot" and the discovery of a Major Howard who had been doing the great work.

I consider this feat of Colonel Howard's one of the great personal performances of World War II, and would very much like to meet him and shake his hand. He deserved the MOH, and there isn't a man of the old 1st Division, 8th Air Force, who was flying to Oschersleben that January 11 who would disagree with me.

David Litsinger
Major, USAFR
Lynwood, Calif.

★ ★ ★

HOW YOU GET AIRMAN

THE AIRMAN is printed for everyone in the Air Force regardless of grade. It is distributed free to all active Air Force units, Air Reserve Centers, and Air National Guard organizations. It is impossible to print a copy for everyone so each copy must be circulated. Distribution is made through the Publications Distribution Officer as recommended by the Information Services Officer.

Subscriptions are available to those who desire them. For convenience, a subscription blank is printed below. Make all checks or money orders payable to Treasurer of the United States.

Superintendent of Documents
U. S. Government Printing Office
Washington 25, D. C.

Please send THE AIRMAN for one year to the following address. Enclosed is a check or money order for $3.50.

Name_____

Address_____

City_____ State_____

UNITED NATIONS

Peacelift

On July 7, 1960, the Security Council of the United Nations extended the hand of friendship to a new member of the family of independent nations as it endorsed the application of the Republic of the Congo for membership in the U. N. The new state of 14 million people in the heart of Africa assumed its independence on July 1 after 80 years under Belgian rule.

Unfortunately, the birth of the new republic was accompanied by convulsive spasms that racked every nerve and fibre of the infant nation. As violence spread through towns and villages, essential public services were interrupted; food supplies became dangerously depleted; and the threat of epidemic disease raised its ugly head.

In response to an urgent plea for assistance from the Congo Government, Secretary-General Dag Hammarskjold of the U. N. summoned a meeting of the Security Council on July 13 to consider the request. In speaking for the Council, U. S. Representative Henry Cabot Lodge said, "We confront a situation which is developing hourly—not daily, or weekly, but hourly."

In the early morning of July 14, Secretary-General Hammarskjold was authorized to take necessary action under Articles 41 and 42 of the U. N. Charter. The small countries to which he appealed for troops responded with immediate pledges. From the United States, Great Britain, and others, he requested airlift—the only practical means of conveying troops and equipment to the scene in time. When the word was passed, the USAF contribution to the U. N. effort took to the air with the polished precision of a well-oiled machine.

Photos by TSGT Lloyd A. Borguss, Hq M

Moroccan troops board a C-124 Globe[illegible]*er at*

On the flightline at Accra, well-equipped troops from Ghana prepare to board a MATS C-124 to join forces of other nations serving with the United Nations in the troubled Republic of the Congo.

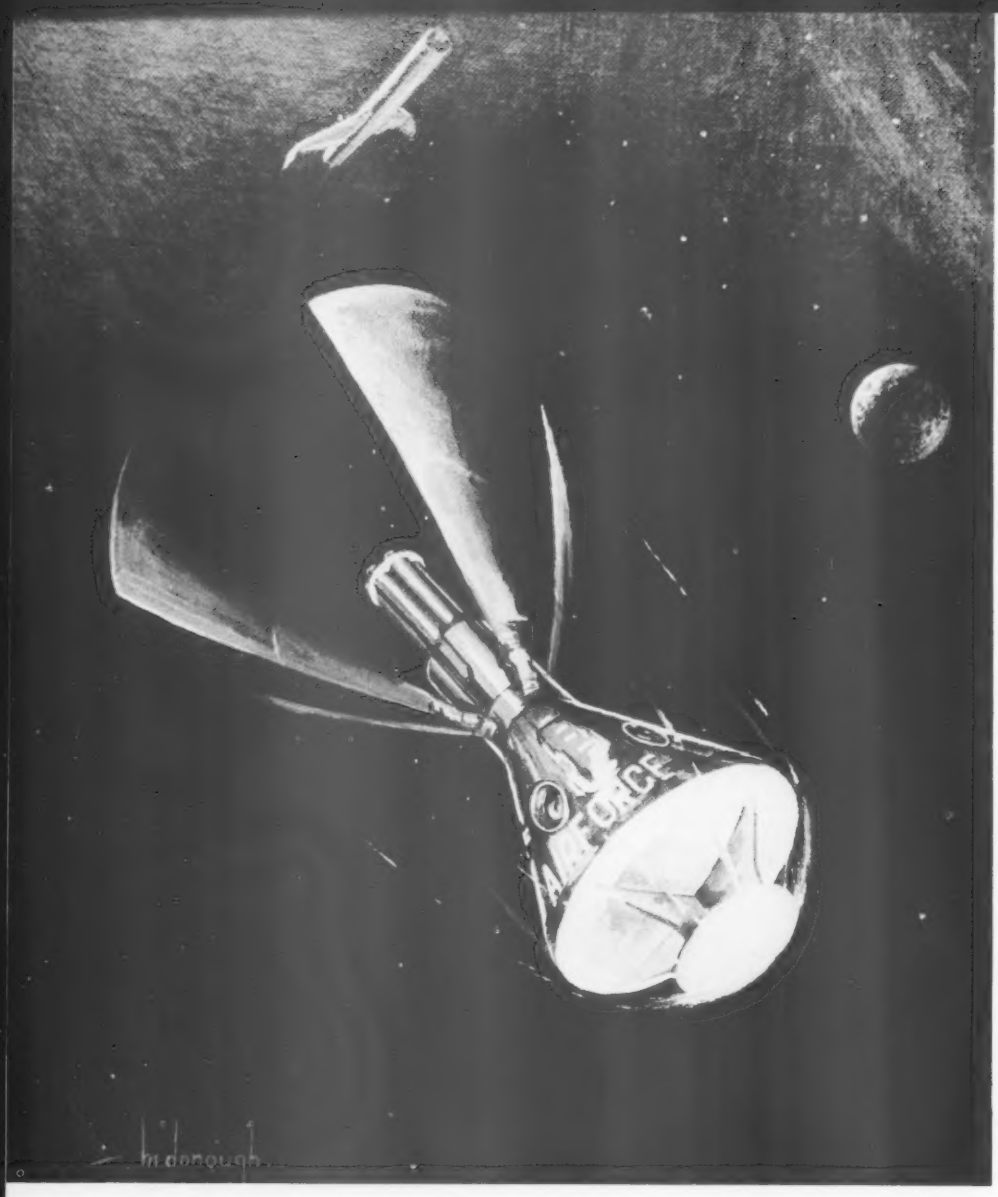
In the first week of Peacelift USAF planes in service of U. N. transported 400 tons of flour for Congolese people, 25,000 C-rations for U. N. troops, as well as maintenance equipment and communications facilities.

U. N. troops from Sweden were serving in the Middle East as emergency occurred in the Congo. Troops flew from Cairo south to Leopoldville via aircraft provided by request of the U. N.

24 Globemaster at Sidi Slimane to support U. N. peace effort in Congo.

A soldier's problems are weighty. With full field equipment, this trooper from Morocco leaves the plane to join his U. N. comrades.

Crew rest! In the warm African night, MATSmen sleep outdoors.



AIRMANS WORLD

Something New in the Airman's World

This artist's concept depicts one of the possible future applications of the *Rotochute* which is being studied by Kaman Aircraft Corp., Bloomfield, Conn., in a contract with the Air Research and Development Command. In this application the *Rotochute* would provide initial deceleration for a manned capsule being returned from orbit. Further down in the atmosphere the *Rotochute* idea—working on the same principle as a helicopter—could be used to further slow the capsule's re-entry and guide it to a chosen landing site. Kaman has already built and made experimental drops with more than 1500 *Rotochutes*. The new contract requires the addition of guidance controls to present *Rotochutes* and a study of the feasibility of using *Rotochutes* in the return of large rocket boosters, nose cones, and manned space capsules from beyond the atmosphere.

BITS OF BLUE

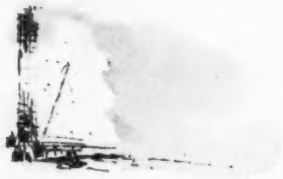
. . . SAC's 379th Bomb Wing (Medium) will change home base early next year when it moves from Homestead AFB, Fla., to Wurtsmith AFB, Mich.

. . . Last month North American Aviation, Inc., began delivery of the first of 42 T-39 *Sabreliners*, a twin-jet combat readiness trainer.

. . . The Bendix Corp. has announced development of a "Go-No-Go" gauge designed to monitor aviation fuel cleanliness during refueling operations and cut off the flow when water or contaminated solids are detected.

. . . Air Force Cambridge Research Center recently revealed that a furnace in its Electronics Research Directorate has produced first-class industrial diamonds in less than 10 minutes.

. . . Because of a new policy of utilizing warrant officers in company-grade officer positions, the selected-assignment warrant officer function has been transferred from Warrant Officer and Airman Assignment to Officer Assignment Division at Hq USAF.



9,000-Mile *Atlas* No "Super" Missile

Contrary to widespread reports, the *Atlas* ICBM 56D, which placed an operational-type nose cone on a target more than 9,000 miles from launch at Cape Canaveral, Fla., was not one of the newer "super" missiles.

The record *Atlas* shot of May 20 was the 27th of the D series fired since April 14, 1959, and was identical in power to the 26 Ds that preceded it and the five that followed it up to July 11.

An advanced "E" series is scheduled for test firings this year. Its new MA3 engines will have a 389,000-pound thrust at sea level compared to the 360,000-pound thrust of the present D model.

PCS First, TDY Second

Airmen off to TDY at school and concurrent PCS can now get PCS orders first, allowing them and their families to travel to the new duty station before reporting to school. A letter from Hq, USAF, to all major commands implements the new policy designed to preclude hardships through extended TDY to schools of instruction in connection with PCS. In the past, Air Force families often found it necessary to make two moves instead of one, with normal reimbursements allowable for the PCS move only.

Under the new rule, personnel scheduled to attend courses which exceed 30 days will get PCS orders requiring the individual to proceed directly to his new permanent duty station with a specified reporting date. The same order will also include instructions to proceed to the school after reporting to the new station.

Individuals can thus establish accommodations for their families at their new permanent station, and be interviewed by the new commander. Realizing that individual circumstances vary, the policy also allows waivers of this procedure when the losing commander, after interview with the assignee, determines that TDY enroute to the new station is more practical.

TAC's TROPICAL TRAVELERS — Strange and unusual areas of the world are home to hundreds of TAC's airmen with Composite Air Strike Forces. Here three aircraft (F-100, RF-101 and C-130) in the force form a pictorial backdrop for two Thailand women at Don Muang Air Base, Thailand. So far this year the CASF has operated from civilian and military airfields in Spain, Pakistan, Philippines, Bermuda, Guam, Azores, Turkey, Taiwan, Iran and Hawaii.

Photo by SSgt. Frank Ketchie

Medical Specialists Increasing

The percentage of certified medical specialists in the AF Medical Service compares most favorably with the distribution in civilian medicine, the Surgeon General's Office recently reported.

As of 30 June, about one third (or slightly more than 1,000) of the physicians on duty were certified or qualified for certification in clinical medical specialties by one or more of the American Boards. In 1949, when the Medical Service was first established, the number of specialists on duty was less than 20.

A specialist is a physician who has completed prolonged post-graduate work in certain specialized areas such as gynecology, psychiatry, cardiology, etc. There are approximately 33 such categories of specialists in the Air Force today.

New Minimum On-station Tours for Officers

To insure greater stability of officer assignments and reduce the frequency of PCS moves, USAF has established a minimum 18-month duty tenure at all stations. The requirement takes precedence over foreign service selection dates as well as other assignment criteria, including PCS to school.

Exempt are those officers completing an overseas tour or training course of less than 18 months duration; assigned to units being inactivated or relocated; approved for humanitarian reassignment; selected or nominated prior to July 1, 1960, for reassignment or attendance at a PCS school at a later date.

OVER AND OUT! This sequence-camera composite photo shows the operation of a new rocket catapult seat-ejection system developed by Republic Aviation Corp. for its F-105D fighter-bomber. Starting at the lower left: ejection begins with an explosive cartridge blast, followed immediately by rocket ignition to lift the pilot and seat to the top of his trajectory. As he descends via parachute, the seat itself hurtles on at greater speed. The 200-foot boost is designed for safe escape in operations below ejection levels.

THE NEW B-52H equipped with P&W turbofan engines and other major improvements is scheduled to make its debut in SAC in the near future. This B-52G test bed was used by engineers to check performance of the new engines. The B-52H will be armed with solid-fueled *Sky Bolt* ballistic missiles to serve as a high-speed, ever-shifting launch platform in the sky. The B-52G now carries the jet-powered *Hound Dog* air-to-surface missile.

Re-Startable Rocket Engine Developed

A rocket engine that can be turned off and on at will to control the position and direction of space craft has been developed by ARDC and the Bell Aerospace Corp.

Heralded as a solution to one of the major problems associated with space ventures, a liquid-fuel engine has been started, shut down, and restarted under simulated conditions approaching a total vacuum. Designated the Bell 8081 engine, it is an advanced version of the model used in the current *Discoverer* satellite vehicles.

A single re-startable engine would eliminate many of the complex controls of multistage missiles, and would permit greater payloads with increased reliability. Re-start of rocket engines is of particular interest to space travelers interested in changing orbit without the initial weight penalty of multistaging.

Practical Problem

It isn't often that a student gets a chance to put his knowledge to practical use while still in school—but that is precisely what happened to Lt. Jack Moore at Stead AFB, Nev.

Lieutenant Moore and his instructor, Capt. Phillip Maggart, were on a helicopter instrument navigation flight when they noted a figure below waving to gain their attention.

Receiving permission from the home tower to land and investigate, the pair found a honeymooning couple, lost and wandering in the Nevada desert. They had strayed from the highway in search of a shortcut, been forced to abandon their car when it bogged down in the sand, and were stranded without water some 50 miles from the nearest road.

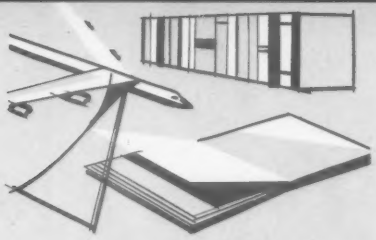
The couple was returned to Stead for observation and minor treatment.

Tow Tractor Developed

Officials at Wright Air Development Division, Wright-Patterson AFB, Ohio, have announced acceptance of a new tow tractor capable of moving combat-loaded B-52s under adverse weather conditions.

Programmed for fall delivery, before winter's first storms, the tractor can move fully loaded B-52s over six-inch ice sheets, up minor inclines, at speeds of approximately six m.p.h.

The principle upon which the tractor was developed is that of applying torque directly to the aircraft wheels. Coupling and uncoupling time has not been changed appreciably from that of previous equipment.



Air Age Library

ROCKETS AND MISSILES

Starbound, The Story of Rocketry, Eileen and Raymond Schussler, tells of the past, present, and future of rocketry and the space age. The narrative begins with Chinese experiments 200 years before Columbus discovered America and covers the field up to the present. G. P. Putnam's Sons ($2.95).

Putnam also has released a new Eric Bergaust work titled *Rockets of the Army,* ($2.50). Done in typical photo-journalism style, it makes a handy reference addition for two other Bergaust productions, *Rockets of the Air Force* and *Rockets of the Navy.*

Air Force Lt. Col. Kenneth Gantz has edited *Nuclear Flight,* an authoritative and detailed report on USAF progress in the field of nuclear propulsion. Told through reports by some of the nation's top experts. Duell, Sloan and Pearce ($4.00).

GENERAL AIR BOOKS

Irwin Stambler is the author of a new book entitled *Find a Career in Aviation.* It lists job opportunities and generally outlines the courses of study which will be most helpful to youngsters desiring to train for a future in aviation. G. P. Putnam's Sons ($2.75).

Putnam's has also released a new David C. Cooke book *Racing Planes that Made History,* ($2.50). It fits well with other Cooke historical accounts of transports, bombers, and fighters.

Air Force Capt. Paul L. Briand, Jr., an instructor at the Air Force Academy, has written an excellent biography of one of America's most famous women fliers entitled *Daughter of the Sky: The Story of Amelia Earhart.* Duell, Sloan and Pearce ($3.95).

Rocketship X-15: A Bold New Step in Aviation, Myron Gubitz, relates the complete story of the current program and includes biographical sketches of the pilots and background material on preceding X-series programs. Julian Messner, ($4.95).

RELATED READING

Readers interested in the role of international political maneuvering will be interested in *The Blowing Up of the Parthenon,* by Salvador de Madariaga, one of Spain's leading writers. It has been released in this country by Frederick A. Praeger ($2.95).

You Ask It

Proficiency pay and proficiency testing are subjects which bring repeated questions from our readers. The following are a few of the general questions which seem to be the most puzzling.

If a man fails to reenlist within a 24-hour period, will he lose his proficiency rating?

Yes. He will then have to wait an additional six months before he can regain pro pay.

Is retention of pro pay automatic when you reenlist immediately?

Not exactly. Although a reenlistee is eligible without requalification, new orders must be cut on the day of reenlistment.

Can an airman receiving pro pay lose that pay by being AWOL?

No.

Are there any components barred from receiving pro pay?

Yes. Reserve personnel who are not on active duty and retired personnel who serve on active duty for periods of less than 31 days are not authorized pro pay regardless of their AFSC.

I understand that Airman Proficiency Tests are scored by machine. Isn't it possible that the machine can be wrong and indicate a failing score when you have actually passed the test?

As long as you report the correct test number on the answer card, it is virtually impossible for the machine to be wrong as every test answer is checked several times in the scoring process.

Without the human element as a double-check, isn't it possible to beat the machine by answering every answer block?

No. These machines are virtually foolproof. In more than 200,000 tests which have been scored, it has never been beaten.

Isn't it true that it really isn't necessary to study for these tests as you are almost certain to pass them the second time even if you fail in your initial attempt?

No. Studies have proved that if a person scores less than 50 percent on a 7-level test or less than 30 percent on a 5-level test, the odds are that he will also fail the exam on the second effort.

How are APT scores judged?

Scoring is based on the number of correct answers obtained by all airmen tested at a given time. Consequently, a passing score may vary according to the degree of test difficulty.

SATELLITE AND SPACE PROBE SUMMARY

Compiled by the U. S. Air Force's National Space Surveillance Control Center, Bedford, Mass., as of August 1, 1960

SATELLITES IN ORBIT		SOURCE	LAUNCH	PERIOD Mins.	APOGEE Statute Miles	PERIGEE Statute Miles
1958 ALPHA	Explorer I	US	1 Feb 58	107.8	1191.0	213.9
1958 BETA I	Rocket Body	US	17 Mar 58	138.3	2683.1	407.2
1958 BETA II	Vanguard I	US	17 Mar 58	133.9	2450.9	406.6
1959 ALPHA I	Vanguard II	US	17 Feb 59	125.5	2049.7	349.3
1959 ALPHA II	Rocket Body	US	17 Feb 59	129.6	2278.0	345.6
1959 DELTA	Explorer VI	US	7 Aug 59	unknown	unknown	unknown
1959 EPSILON II	Capsule	US	13 Aug 59	99.3	778.4	120.2
1959 ETA	Vanguard III	US	18 Sep 59	129.9	2321.1	318.0
1959 IOTA I	Explorer VII	US	13 Oct 59	101.2	672.9	343.7
1959 IOTA II	Rocket Body	US	13 Oct 59	101.1	669.0	343.1
1960 BETA I	Rocket Body	US	1 Apr 60	99.1	466.7	428.9
1960 BETA II	Tiros I	US	1 Apr 60	99.2	468.3	428.9
1960 GAMMA I	Rocket Body	US	13 Apr 60	94.4	420.6	194.3
1960 GAMMA II	Transit IB	US	13 Apr 60	95.5	443.2	237.7
1960 GAMMA III	Metal Object	US	13 Apr 60	93.6	384.2	177.2
1960 EPSILON I	Sputnik IV	USSR	15 May 60	94.0	402.2	181.0
1960 EPSILON III	None	USSR	15 May 60	94.1	418.6	172.2
1960 EPSILON IV	None	USSR	15 May 60	94.0	406.4	175.5
1960 EPSILON V	None	USSR	15 May 60	91.7	269.8	175.5
1960 EPSILON VI	None	USSR	15 May 60	91.7	268.0	176
1960 EPSILON VII	None	USSR	15 May 60	91.3	244.9	175.5
1960 EPSILON VIII	None	USSR	15 May 60	92.0	287.1	175.5
1960 EPSILON IX	None	USSR	15 May 60	92.2	299.1	175.5
1960 ZETA I	Midas II	US	24 May 60	94.4	318.6	300.1
1960 ZETA II	Metal Object	US	24 May 60	94.0	300.8	291.9
1960 ETA I	Transit 2A	US	22 Jun 60	101.7	650.5	389.2
1960 ETA II	Greb	US	22 Jun 60	101.7	657.8	381.8
1960 ETA III	Rocket Body	US	22 Jun 60	101.4	639.4	383.0

LUNAR/SPACE PROBES		SOURCE	LAUNCH	STATUS
PIONEER IV		US	3 Mar 59	Orbiting Sun (1st Space Probe)
LUNIK I	(Mechta)	USSR	2 Jan 59	Orbiting Sun
LUNIK II		USSR	12 Sep 59	Hit Moon — 13 Sep 59
PIONEER V	(60 ALPHA)	US	11 Mar 60	Orbiting Sun

DECAYED SATELLITES		SOURCE	LAUNCH	DOWN
1957 ALPHA I	Rocket Body	USSR	4 Oct 57	1 Dec 57
1957 ALPHA II	Sputnik I	USSR	4 Oct 57	Early Jan 58
1957 BETA	Sputnik II	USSR	3 Nov 57	14 Apr 58
1958 GAMMA	Explorer III	US	26 Mar 58	28 Jun 58
1958 DELTA I	Rocket Body	USSR	15 May 58	3 Dec 58
1958 DELTA II	Sputnik III	USSR	15 May 58	6 Apr 60
1958 EPSILON	Explorer IV	US	26 Jul 58	23 Oct 59
1958 ZETA	Atlas	US	18 Dec 58	21 Jan 59
1959 BETA	Discoverer I	US	28 Feb 59	Early Mar 59
1959 GAMMA	Discoverer II	US	13 Apr 59	26 Apr 59
1959 EPSILON I	Discoverer V	US	13 Aug 59	28 Sep 59
1959 ZETA	Discoverer VI	US	19 Aug 59	20 Oct 59
1959 THETA	Lunik III	USSR	4 Oct 59	About 20 Apr 60
1959 KAPPA	Discoverer VII	US	7 Nov 59	26 Nov 59
1959 LAMBDA	Discoverer VIII	US	10 Nov 59	8 Mar 60
1960 DELTA	Discoverer XI	US	15 Apr 60	26 Apr 60
1960 EPSILON II	Rocket Body	USSR	15 May 60	17 Jul 60

In the Name of Congress

No. 25 IN A SERIES

SINGLE PLANE MISSION

by SMSgt. Hal Bamford

By mid-1944, 20th Air Force B-29s were making their presence felt in the Pacific, but

EARLY IN 1943, two apparently unrelated events occurred at Air Force stations half a world apart. The principals in these two events—a man and an organization—were marked by destiny. Eventually the man, as a member of the organization, would join the growing list of heroes who earned this nation's highest military decoration.

In China, the organization—the 308th Bombardment Group—arrived at its new station from Stateside and became the first B-24 unit assigned to Gen. Claire Chennault's 14th Air Force.

Almost simultaneously in New Mexico, the man—Horace S. Carswell, Jr.—was promoted to major and boosted to command of the 356th Bombardment Squadron at Clovis Army Air Base.

In the China War, the 308th's arrival meant new range for General Chennault's renowned outfit, still famed largely for its Flying Tigers.

For Major Carswell, his promotion and assignment meant the beginning of a new section of the road, command and staff experience, which would lead to fame in southeast China.

In reality, the Carswell portion of the story begins three years earlier when this Fort Worth native joined the Air Force as an Aviation Cadet in March 1940. During his months of flying training, his leadership ability became evident and he rose through the Cadet officer ranks as a result. On November 16, 1940, Carswell graduated from Advanced Flying School at Kelly Field, Tex., and was commissioned a second lieutenant.

His flying ability had been as distinguished as his leadership and his first post-graduate assignment was as an instructor at Randolph. However, after only two months in this role, his superiors decided his talents deserved better things and he was sent to Goodfellow where he was elevated to the role of flight commander of an operational organization. The following July, he was scheduled for Combat Crew School in Florida.

Promotion came almost as rapidly as transfer in those early days and, as 1943 dawned, combat training behind him, Captain Carswell took up the new duties of flight commander in the 355th Bomb Squadron at Davis-Monthan AB, Ariz.

Here again, his inherent leadership came to the fore and he moved on to Clovis and squadron command. Within months, a new move took him to Langley Field, Va., where in a few brief months he rose to command a bombardment group after experience in group operations and as deputy commander.

Now his education was complete and Major Carswell was finally posted to combat duty early in 1944 as a member of the 374th Bombardment Sq., 308th Group.

Although the 308th had been in China over a year by now, they had been several months attaining true combat proficiency. After their arrival in March, they did not fly their initial combat mission until May because of necessary modifications to their B-24s.

However, once they began operations, they quickly became a major factor in the theater's air war, roaming far and wide and attacking a multitude of targets ranging from airfields to shipping and troop concentrations.

Missions took them up and down the east coast of China, far into the interior, and down into the smaller nations south of their main base.

Major Carswell arrived at the organization just in time to join the 308th's counterattack against Japanese forces who were striving to capture the Peiping-Hankow railroad. His first missions were flown as a member of the units assigned to knock out the Yellow River bridges in an attempt to deny supplies and reinforcements to enemy forces driving at this vital link.

Despite the best efforts of the 308th and other air units in China, by June Japanese gains were expanding

other aircraft were still carrying the major load in pursuit of the air war against Japan.

and it was evident that a major offensive was in full swing. General Chennault's forces found themselves fighting defensively simply to maintain their bases.

However, Allied forces were growing and by midsummer, in addition to the planes in China and the many island bases, the heralded B-29s began arriving. This added strength caused commanders in China to gamble on a revised type of operation. While destruction of enemy aircraft remained the principal goal, Japanese shipping along the rivers and in waters adjacent to the coast moved up to second place on target lists.

Even this revision in plans failed to stay the Japanese war machine which slowly continued its advance, forcing the Chinese ground forces back and causing American air units to abandon many forward fields. At the same time, supplies from over the Hump failed to keep pace, often reducing major plans to minor raids of little more than nuisance value.

Even these overwhelming odds failed to dampen the ardor of American air crews and they accepted every opportunity to strike the enemy. It was under such conditions, on the night of October 26, 1944, that Major Carswell volunteered to undertake a one-plane strike against Japanese shipping in the South China Sea.

Resultant action is graphically detailed in the citation published in War Department General Order 14, 4 February 1946, awarding USAF's 34th Medal of Honor.

He piloted a B-24 bomber in a one-plane strike against a Japanese convoy in the South China Sea on the night of 26 October 1944. Taking the enemy force of 12 ships escorted by at least two destroyers by surprise, he made one bombing run at 600 feet, scoring a near miss on one warship and escaping without drawing fire. He circled, and fully realizing that the convoy was thoroughly alerted and would meet his next attack with a barrage of antiaircraft fire, began a second low-level run which culminated in two direct hits on a large tanker. A hail of steel from Japanese guns riddled the bomber, knocking out two engines, damaging a third, crippling the hydraulic system, puncturing one gas tank, ripping uncounted holes in the aircraft, and wounding the copilot; but by magnificent display of fighting skill, Major Carswell controlled the plane's plunge toward the sea and carefully forced it into a halting climb in the direction of the China shore. On reaching land where it would have been possible to abandon the staggering bomber, one of the crew discovered that his parachute was ripped by flak and rendered useless; the pilot, hoping to cross mountainous terrain and reach a base, continued onward until the third engine failed. He ordered the crew to bail out while he struggled to maintain altitude, and, refusing to save himself, chose to remain with his comrade and attempt a crash landing. He died when the aircraft struck a mountainside and burned. With consummate gallantry and intrepidity, Major Carswell gave his life in a supreme effort to save all members of his crew. His sacrifice, far beyond that required of him, was in keeping with the traditional bravery of America's war heroes.

The major's medal was the first awarded to an airman in the Pacific area since November 2, 1943. (See *Return to Rabaul*, Jan. '60.)

In months that followed, Major Carswell's comrades, who gained inspiration from this heroic exploit, would aid immeasurably in turning back the surging mainland offensive and signal the end of Japanese domination.

After the cessation of hostilities, a grateful Air Force was moved to remember the inspiring deeds of this quiet but forceful officer by naming an installation near his hometown in his honor. Today, SAC's Carswell AFB, Tex., stands as an active monument and a constant reminder of a 28-year-old Texan who, against overwhelming odds, never faltered in his determination.

Salute to an amazing AWOL

From the genius of a gun-shy foot soldier comes the secret of today's Missile Defense Alarm System.

by William A. Kinney, *Airman Staff*

WHEN the first operational *Midas* satellite is successfully injected into orbit, designers of its instrumentation will owe a real debt to a man who went AWOL and proceeded to make a smashing success of that normally risky business.

His name was William Herschel and he can't be denied a place in the picture, because he discovered the existence of infrared radiation, the invisible electromagnetic waves produced by heat sources. It is the capability of detecting such radiations from the burning fuel of rocket engines in flight which gives the *Midas* its mission.

Herschel unquestionably earned a place in the company of the greatest scientific figures to grace recorded history but his story fits none of the usual patterns; at times it has the theatrical pace and unexpected turns of a Hollywood scenario.

His beginnings were undistinguished, with scant note of promise. He was born in 1738 in what was then the small independent principality of Hanover, a state later incorporated into the unified Germany of the next century. He sprang from an obscure and humble family, perennially harrassed by money troubles and only unusual in that most of its members were more musically inclined than others in their level of life. It is not surprising, therefore, the growing boy early evinced a marked talent for music and a great devotion to its study. In other subjects his schooling was elementary, almost superficial. For a while he seems to have been intrigued by the mysterious beauty of the remote heavens but this was a passing flirtation; music was overwhelmingly his great young love.

Life's first big change came when he was still in his teens. Eligible for military service, he found himself on the roster of the Hanoverian Foot Guards. As happens occasionally for some, military life proved less than appealing. Hanover became engaged in one of Europe's small wars during 1757 and Herschel had his baptism of fire. Although his unit was held in a supposedly safe rear area during a decisive engagement, gunfire made the position rather unhealthy so the youth took off for home in the interest of safety.

After an absence of some days, Herschel blithely reported back to his regiment which had returned to Hanover's capital city after taking something of a mauling in the battle mentioned. Whether it was because administrative chaos prevailed in the unit, or the Hanoverian military establishment was amazingly indulgent on the matters of AWOLs, the youth was subjected to no punishment. It was almost as if he hadn't been missed. Despite his new try, garrison life palled fast. In two months he was completely fed up, went over the hill, then across the Channel to the sanctuary of London where he arrived in November of that year.

His musical ability soon brought a job as a church organist and Herschel was able to supplement his earnings by teaching music. In 1766 he went to Bath, the country's most fashionable spa and swank social resort, and a highly rewarding move it was. He began there as an organist, but swiftly soared to prominence as the community's music master and one of England's leading musical authorities. His violin recitals drew enthusiastic audiences; he appeared as conductor of 100-man orchestras and large choruses; his compositions evoked critical acclaim and pupils flocked to his music classes.

Despite Herschel's enormous success in the realm of music, the maestro was becoming mentally restless. There is a hint of the measure of the man in the fact

that although he maintained a staggering schedule—he worked 14 hours a day, occasionally longer—the musician began casting about for something else to do. Perhaps his boyhood curiosity about the heavens had been with him all the while, for at 35 the maestro abruptly took up astronomy seriously as a hobby. It was 1773, a year memorable elsewhere for the Boston Tea Party.

Never one for doing things halfway, Herschel now read omnivorously on that subject and related mathematical works. There was also the matter of shopping for a telescope, instruments then comparatively rare and expensive. When he could find none large enough to make possible the observation program forming in his mind, he unhesitatingly built one of his own, aided only by his younger sister, Caroline.

When this confident amateur turned to astronomy as a diversion, the science was in a largely passive period. Techniques tended to be rigid. Outworn theories went unquestioned. For the most part, the fertile imagination and creative thought that had marked its long history seemed to have strayed elsewhere.

Unhindered by Tradition

Herschel began his observations untrammelled by preconceived notions or previous apprenticeship in contemporary routine and methods. Indeed, his do-it-yourself telescope represented an important advance for such instruments. Its mirror was twice the size of the largest then in use by the professionals. Moreover, he had developed a new optical system designed to provide greater magnification so that he could pick out stars that were either naturally dim or else appeared as feeble points of light by reason of their great distances from earth. Equally novel for the day was that he took as his personal hunting preserve all of the heavens within the range of his telescope.

Soon he was identifying new stars but his work attracted no extensive professional attention. Since he was still carrying his crowded schedule as a musician, the hours remaining for his hobby were limited. Then came 1781—the year of American victory at Yorktown—and Herschel discovered Uranus, the first of the major planets that had been unknown to sky watchers of the ancient world.

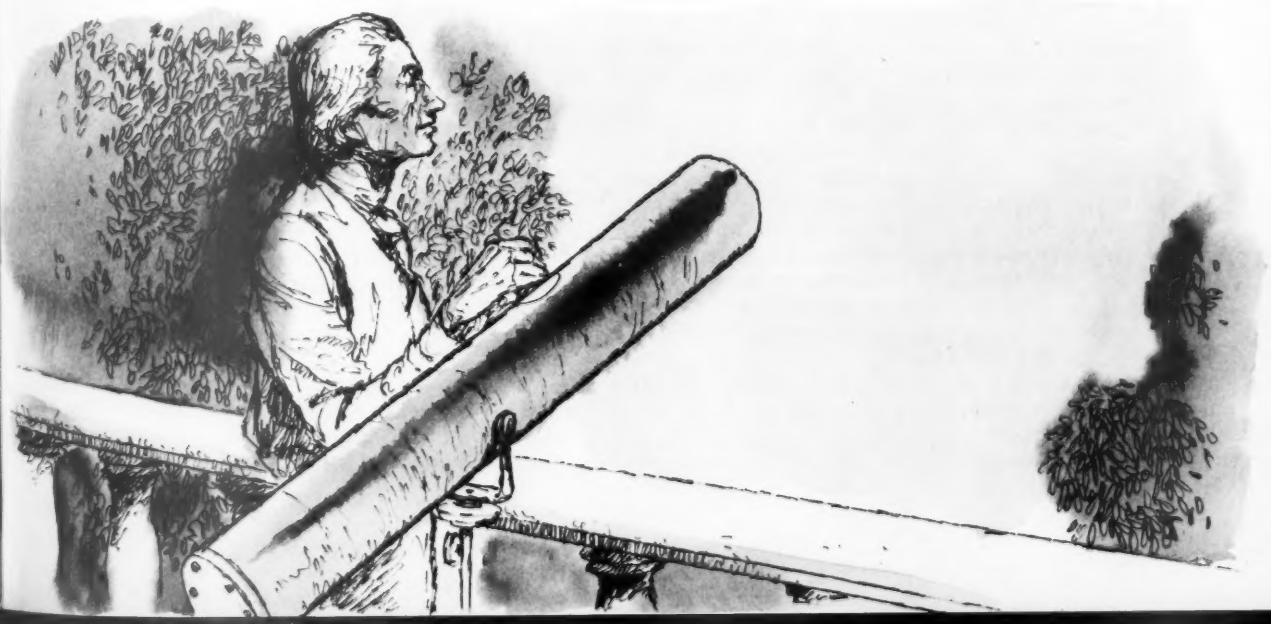
To be frank, he wasn't quite sure just what he had found immediately. His first surmise was that he had chanced on a new species of comet. Then he decided it must be a star. Only later was he able to identify it positively as a planet. After a considerable lapse of time he exercised his prerogative as the planet's discoverer and called it *Georgium Sidus* (Star of George) as a compliment to the reigning monarch, George III, the same who had just lost a war to his American subjects.

Although this name was not destined to survive, it endured in England—alternately with the "Georgian planet"—until the middle of the next century. Elsewhere in Europe the name, like the sovereign who bore it, was never popular. Joseph Lalande, a contemporary French astronomer, suggested it be called "Herschel" instead, but that idea failed to catch on. Finally a noted German member of the fraternity proposed Uranus as in keeping with the classical nomenclature of the rest of the solar system, and the name was universally adopted later.

The original naming of the planet spawned a very fetching legend which survives until this day even in some reference works of note although its factual basis is sadly wanting.

Faux pas *of the Century*

According to this tale, when Herschel fled to England a deserter in 1757, he was so unschooled politically that he was unaware that the British sovereign was also the ruler of Hanover. This had been true since 1714 when the head of the House of Hanover succeeded to the British throne by virtue of his descent from James I of England. So the purported picture was that Herschel, seeking sanctuary as a deserter, had unwittingly picked a country where his abandoned sovereign was also very much the king.



To continue with the scenario, George III was quite excited by the discovery of the new planet and flattered to have it named for him. He expressed his royal pleasure and let it be known he was of a mind to reward this remarkable part-time observer. When Herschel was brought to his presence, the King is supposed to have opened the audience with a sardonic display of off-beat humor by condescendingly handing the man a pardon for deserting the Hanoverian Foot Guards more than 20 years earlier. Then, to show his forgiving nature, he proceeded to confer knighthood on Herschel.

So much for the fable; actually, the future astronomer had received an official pardon in 1762 for going AWOL. Indeed, there was some question whether technically he had ever been a deserter. This arose because of some uncertainties as to whether he had been properly sworn in when first accepted for service and also due to the nature of the military subunit to which he had been assigned.

As for the knighthood, that came along in leisurely fashion but it was bestowed in 1816 by the Prince Regent, six years after George III became insane and could no longer rule.

The fact that Herschel had no immediate contact with the King after discovering Uranus is of little consequence. The find quickly vaulted the German musician to international fame. In Britain's closed society of professionals, some were slow or dubious about accepting the fellow whose invasion of astronomy had been so unorthodox and improvised, but even these could not persist in their ostrich roles very long.

Herschel was lionized, feted, and acclaimed by the big names of the day and in the best of circles. Sudden fame can be a heady wine and the maestro was human enough to enjoy the adulation and his new status, but only to a point. After a few months of surrendering himself to the aimless and frivolous occupation of being a current idol, he purposely put it aside and got back to his music and the scientific hobby it financed.

Farewell to the Fleshpots

King George III eventually got around to receiving and congratulating his distinguished subject, but it was not until in May 1782, a year after the new planet's discovery. A few months later the King directed him to forsake his musical career and devote his full energies to astronomical work under Royal Patronage.

Herschel embraced the opportunity with enthusiasm although his new official status was left on the vague side, inasmuch as the post of Private Astronomer to His Majesty already was filled. Free at last to give astronomy his main attention, the erstwhile musician set out on a career which was to be nothing less than spectacular. His approach, in the disapproving eyes of so many conservative professionals, was strictly free-wheeling. When a telescope's power became inadequate for his purposes, he thought nothing of constructing a better instrument to replace it. Previously, reputations had been reared on the identification of anywhere from a score to a hundred new stars. With Herschel, the discoveries ran into the several thousands, including stars, nebulae, binaries, nebulous stars, and star clusters. He found the polar caps of Mars, the first two satellites of Uranus, two more of Saturn's moonlets, and developed new data on the Sun and major planets. Several times he made complete surveys of all the heavens visible from Britain, each time probing deeper than any astronomer before. The theories he worked out on the motion of the solar system and other celestial phenomena gave his colleagues and generations of their successors challenging new concepts to explore.

In short, he performed like the scientific virtuoso he was. Equally important, he was setting a shining example as the first of a generation of adventurous amateurs who were presently to make greater contributions to the advance of astronomy than the formally schooled professionals of the era, and also to infuse the olden science with new life and spirit.

Money Trouble and a Sharp Solution

Acceptance of the royal commission may well have involved real sacrifices on the part of Herschel. The stipend it carried was only half the income his musical career had been bringing him. It is true that grants

from the exchequer for construction of new instruments and their maintenance were liberal. However, living in the comfortable style to which he had become accustomed would have posed serious financial problems had he not an understanding with his liege which left him free to manufacture in his spare time telescopes for which he hoped to find buyers. Fortunately, he found a waiting market for the instruments and the demand brisk.

Even so, there are suggestions that a financial pinch recurred from time to time. That is until 1788 when Herschel married Mary Pitt, the charming and intelligent widow of a London merchant who had a substantial fortune at her disposal. Monetary worries vanished thenceforth. The brilliant astronomer lived to be 81.

Herschel's discovery of infrared radiation in 1800 is a classic example of basic research—the pursuit of an experiment without an inkling as to what results may ensue. At the time, the scientist was primarily concerned with studies of the Sun. For observation purposes, he had devised several combinations of colored glass and, in the course of trying them, came on one set which virtually excluded all visible light although the astronomer could feel that the solar heat was continuing to come through about normally. Immediately he had further doubts about the accepted theory that light and heat were inseparable physical phenomena, an hypothesis whose validity he had previously rather suspected. Trying other combinations of colored glass, he found some which admitted the light but not the heat.

His next step was to focus sunlight on a glass prism which separated the visible light into a rainbow-like succession of hues. With a thermometer whose bulb he had blackened for maximum light absorption, he then took readings, first in the visible blue light at one end of the spectrum, next in the brilliant yellow band near its center, and finally in the red light at the other end of the spectrum. The thermometer registered the highest temperature when held in the red band.

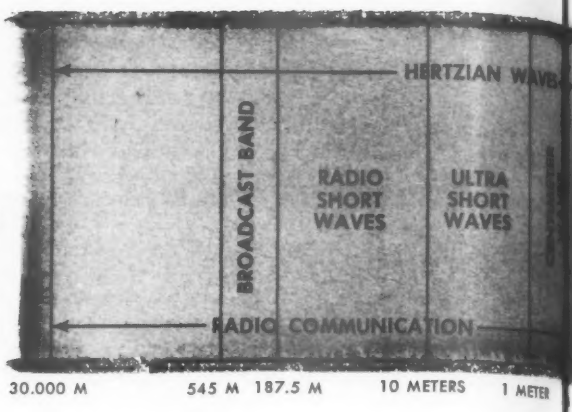
The big surprise came when he moved the thermometer on beyond the red end of the visible spectrum—the temperature climbed even higher! Herschel concluded that there must be an invisible light to account for this effect. From this simple discovery in the year 1800 stem all the infrared devices and techniques which have since come into use to serve astronomy, medicine, chemistry and physics, photography, botany, paleontology, criminology, technology and industry, as well as military purposes.

Numerous other practical applications, utilizing this invisible light, may be expected to emerge in the future both for general civilian use as well as for classified military purposes. Trade publications estimate that the current market for infrared components or devices, plus expenditures for further research and development in this field, has reached a rate of somewhere between $300 to $500 millions annually, with a substantial portion of the outlay coming from defense sources. Sir William Herschel certainly started something when he thought of experimenting with his various combinations of colored glass.

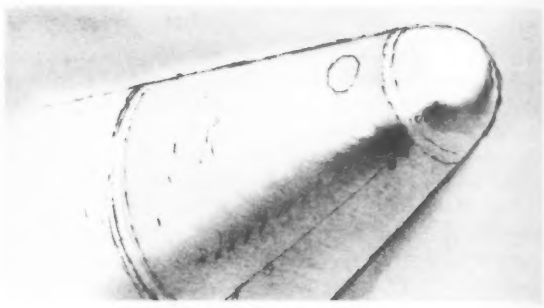
☆ ☆ ☆

Undoubtedly some readers of this article with an inquisitive turn of mind have been wondering all along what Herschel's equivalent to the AFSC was before he decided a military career was not for him and went over the hill. This sensitive information is now no longer classified and it may be disclosed that he was an oboe player in the regimental band!

From Mynheer Huygens to Midas



by William A. Kinney, *Airman Staff*



THE task of making infrared radiation—invisible light—a versatile tool of civilization is a tale of many years, many names, and much patience.

Ever since the first of his breed walked the primordial earth, of course, man has been living with this invisible light, utilizing or recognizing its effects for uncounted centuries without knowing their cause or explanation. Infrared rays baked the bread in his primitive ovens just as it long later spread the cheery warmth from pot-bellied stoves, once a homey symbol of the American scene.

Indeed, man himself has always been a source of infrared light. Let him move into an environment cooler than his normal body temperature, for example, and there will be an increase in the amount of the radiation he emits.

Like so many scientific sagas this one does not proceed logically from the beginning, so to speak. Events do not always occur in an orderly manner.

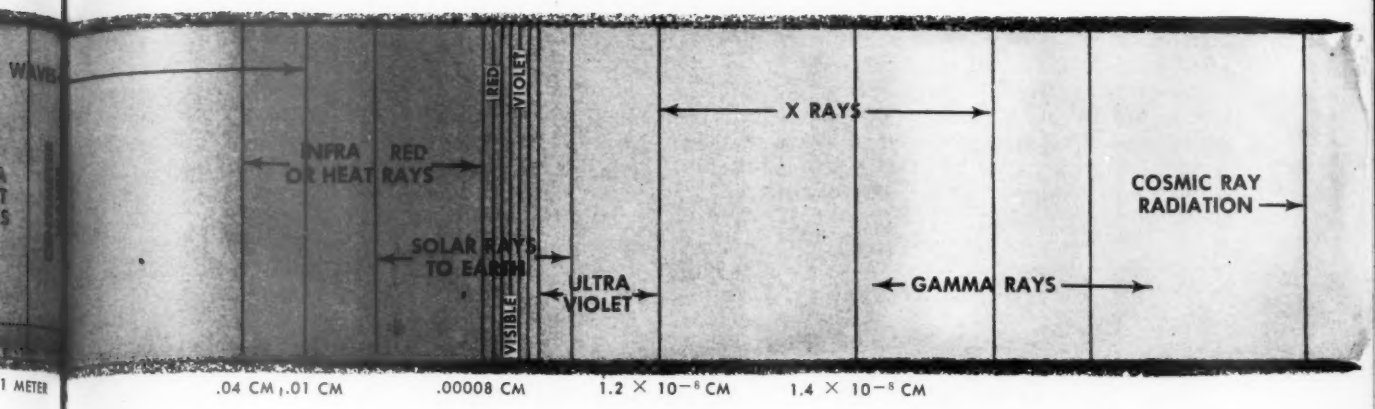
For our purposes, the first significant date is 1690—two years before colonial Massachusetts held the celebrated Salem witchcraft trials. Over in the Netherlands a mathematician and physicist, one Christian Huygens, advanced the then astounding theory that visible light traveled in waves. This concept was considered too fantastic for contemporary scientific belief and contrary to common sense. The paper Huygens had prepared on the subject was relegated to the limbo of physics.

The next revolutionary entry was the work of Sir William Herschel, brilliant English astronomer, who discovered in 1800 that beyond the red end of the visible light spectrum there existed an extension of invisible light with higher temperatures which could be measured. As scientists of the present century were to determine, this infrared band occupies the wavelengths between those of visible light and the frequencies employed by modern radar.

In the same decade as Herschel's discovery, Thomas Young, an English physician and physicist, revived Huygens' wave theory for the movement of light and conducted successful experiments to support the hypothesis. Thus opened auspiciously the 19th century which produced numerous major achievements in basic research, many with cross-fertilizing effects in physics, chemistry, and astronomy.

With 1873 an historic milestone was reached when the very talented Scot, James Clerk Maxwell, synthesizing the results of work by many able predecessors, formulated the theory that all electrical and magnetic energy travels in transverse waves and that light waves, whether visible or invisible, are energy of this nature. Subsequent experiments by later scientists bore him out.

The advent of the present century found the camera already being wedded to the telescope and also the development of delicate instruments which made it possible for observatories to compute the temperatures of distant celestial bodies. Thus astronomy became the first field of knowledge to benefit by infrared techniques.



George Berkeley, a 17th century British philosopher, writing of material things, theorized that "So long as they are not actually perceived by me, or do not exist in my mind, or that of any other created spirit, they must either have no existence at all, or else subsist in the mind of some Eternal Spirit." If true in its literal meaning, man would have no radio, radar, or x rays. In the electromagnetic spectrum shown here, visible light—that which can be perceived by man—occupies but a narrow band in the complete range of electromagnetic radiations measured and used by science today.

The human eye is sensitive to the narrow band of radiation between the red and the violet only, and a few one hundred thousandths of a centimeter in wave length make the difference between visibility and invisibility. The illustration shows the ether spectrum and places in proper perspective the frequency range of infrared. Note its width in comparison to the visible band.

For one thing, there are certain stars and nebular formations which radiate most of their energy on wavelengths higher than those of visible light. Infrared waves, too, do not undergo the distortion that affects visible light reaching the earth from exterior sources. A photograph of Mars taken in infrared light shows a smaller diameter than one made in visible light. This is evidence that the planet possesses atmosphere.

All bodies or substances in the known physical universe whose temperatures are not at absolute zero (−459.6 degrees Fahrenheit) emit temperatures in the infrared range. Since all of the physical elements have distinctive frequencies, it is possible by analysis of infrared radiations recorded to determine the composition of their source.

While infrared radiation is subject to some scattering and absorption in the dense lower atmosphere, the degree is far less than for visible light. Where a haze, for instance, diffuses visible light to such an extent that details in the area become vague and fuzzy, it causes no interference to infrared light unless the moisture content of the haze is appreciable. Substances which do produce interference include water in any form and glass, although in the latter case modern lenses can be made to correct for the effect. Above the denser layers of the atmosphere, interference to the propagation of infrared radiation becomes negligible.

With the *Midas* early warning satellite, the sensors of its instrumentation are designed to detect the infrared radiations from the burning fuel of rocket engines soon after a guided missile or other military space vehicle has left the launch pad. A data link telemetry system transmits the warning information to ground readout stations. Development of the *Midas* system began in March 1957, when a feasibility research study was instituted.

Another valuable military application of Herschel's discovery 160 years ago has been infrared photography. Pictures taken in infrared light have greater clarity of resolution and can get more distant details than are possible with ordinary photography. Moreover, the infrared camera is enormously more difficult to "cheat" with conventional camouflage. It is true that in cases where the photographic objective is limited in size a decoy radiation source could be set up. However, this would have to duplicate exactly the energies emitted by the real thing. Should the radiations involved be complex, the task of contriving a successful deception would be troublesome.

Where a photographic objective is extensive in size, attempts at deception would be about hopeless since it would involve precisely counterfeiting an intricate pattern of numerous radiation causes whose general character could be predicted diagrammatically with good accuracy from existing intelligence. It is true that fog balks infrared photography, but to create such a condition artificially over a sensitive area and maintain it for any extended period of time poses fantastic difficul-

ties. What is more, under circumstances of hostilities it would have the effect of a target marker.

Infrared photographs of landscapes with vegetation have an odd look. Because air pockets in growing vegetable matter reflect most of the infrared light reaching it, the foliage of trees, for example, photographs as if it were either white or completely snow-covered. Water, on the other hand, comes out black. Infrared portraits of individuals have an eerie effect. The eyes and lips photograph very darkly, almost black, while the rest of the face has an extremely light appearance, bordering on the translucent.

For Space Age communications purposes experts believe the capability of new infrared techniques has scarcely been tapped. Immense importance attaches to this because in the not too distance future the radio frequencies available for civilian and military use will be saturated by the increasing volume of traffic and an auxiliary medium for communications will be needed. There has been some use of infrared light in the past for military communications. However, in the dense lower atmosphere its range is only somewhat greater than visual light, utilizing heliographs and kindred devices, although it does have the advantage of being undetectable by the naked eye when being employed.

During and since WW II infrared devices have been used with a variety of weapons, including the sniperscope, the proximity fuse and missiles homing on infrared sources. The Germans relied on infrared image converters and also infrared telescopes for locating Allied aircraft on dark nights and German night fighters also had converter equipment. On the Eastern Front in 1944 Panzer divisions used infrared converters with telling effect against Red armor. The instruments likewise were added to the equipment of U-boats and E-boats, the speedy, small torpedo-carrying craft used in Channel operations. The Germans also developed thermo-locator apparatus which proved of great success in regulating crossroads traffic during blackouts.

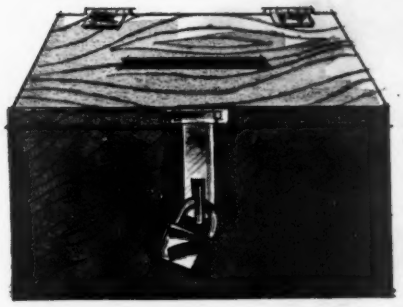
When the Soviets and Nazis concluded their 10-year (so called) "non-aggression pact" in August 1939, among the first things to be sought by the Kremlin's negotiators were the infrared research secrets of Hitler's Third Reich. Most of these fell into Soviet hands in the final phases of the war.

In past tactical employment infrared instruments have demonstrated their chief shortcoming; their range is limited by the fact that infrared propagation is rectilinear and hence is handicapped by rugged or hilly terrain and particularly by the curvature of the earth. The rays behave like ultra-short waves and are subject to the same laws. Since water absorbs infrared radiation, instruments are ineffective in medium or dense fog, rain and snow or through heavy, moist cloud cover.

The world has discovered a great number of interesting and useful things about the composition and characteristics of light since Mynheer Huygens made his remarkable discovery in 1690. It is an area of scientific exploration that is likely to produce many more surprises in the future.

Infrared telescopes were widely used during World War II, but presence of fog impaired effectiveness.

THE IMPORTANCE OF YOUR VOTE



On November 8 millions of Americans all across the country will stream to the polls to cast their votes in the 1960 national elections. Primary attention, of course, is focused on the contest for the highest office in the land and one of the most powerful positions in the world—the presidency of the United States.

Major significance, too, is attached to the Congressional elections in which the voters will make their decision on 33 seats in the Senate (one third of the total complement), and the entire membership of the House of Representatives, 437 seats. The outcome of the Congressional elections will determine whether the 35th President of the United States will have his own party or the opposition in control of legislative policy.

Results of the census of 1960 will dictate certain changes in the composition of the House of Representatives. The Census Bureau estimates that, when final figures are tallied, six states—Arizona, California, Florida, Hawaii, Michigan, and Texas—will be entitled to an increase in the number of Representatives, while 13 other states can be expected to suffer losses. The reapportionment of Congressional seats will not be effective until election of the 88th Congress in November 1962. Total membership in the House of Representatives has been fixed at 435 since 1912 by act of Congress. The present total of 437 includes two seats added temporarily to provide for the admission of Hawaii and Alaska to the Union. The reapportionment of House seats in 1962, however, may have an influence on presidential elections beginning in 1964. Each state elects to the Electoral College as many members as it has Senators and Representatives. (A member of the Electoral College may not be a member of Congress or holder of any Federal office.)

The American Heritage Foundation, an institution devoted to encouraging an increase in registration and voting, predicts that the elections of 1960 will produce the greatest turnout of voters in American history. The percentage of the potential vote is expected to eclipse the previous record of 62.7 percent achieved in President Eisenhower's first election victory in 1952. In the election of 1904 which returned President Theodore Roosevelt to the White House for his first full term, only 24 percent of citizens of voting age cast their ballots.

This vast improvement in the state of national awareness in a period of a little over fifty years is certainly gratifying, but considerable room for improvement continues to exist. In spite of the record-breaking turnout of 62 percent of the voters in 1952, 40 million Americans neglected to take part in the election. As a matter of fact, since the formation of the modern American political parties no President has ever been elected by a majority of all those eligible to vote.

Other nations of the Free World can point with pride to a much higher degree of popular participation in recent national elections. In Austria, for example, 95 percent of the voters trooped to the polls. France showed 89 percent, West Germany 86 percent, Turkey 87.7 percent, Greece and Indonesia 85 percent, and Israel 82 percent.

There are more than 100 million persons qualified to vote in the United States, but too many rationalize their political apathy by leaning on the familiar crutch: "One vote won't make any difference." In 1841 Marcus Morton became Governor of Massachusetts by a plurality of one vote out of aggregate of 100,000. Four votes given to the fifth ward of the City of New York made Thomas Jefferson President of the United States. In 1944 Senator Robert A. Taft carried election in Ohio by less than one vote per precinct, and there are dozens of other examples available to cite the power of the individual vote.

Every year the American people take a more and more active interest in the destiny of the United States. Will you be among those present for duty as a citizen on November 8th?

—TSgt. JOHN K. O'DOHERTY

Flight Planning by the Numbers

by A1C Luther A. Dalton, *Airman Staff*

EUCLID, after a hard day at the chariot races, pulled pensively at his beard, took a long pull from his goblet, and profoundly stated: "A straight line is the shortest distance between two points."

Nobody questioned Euclid, and civilization spent the next two thousand years or so believing that if they traveled in a straight line they would reach their destination in the shortest possible time. This theory worked out fine until the turn of the century and the advent of the air age when someone asked what at first appeared to be an innocuous, although apparently foolish, question: "How does one fly from point A to point B in the least time and (a very important 'and') how does one fly from point A to point B on the smallest amount of fuel?"

Multitudes answered chortling (as if you didn't know): "Fly in a straight line." Others advocated flying at higher altitudes. One wag coyly chirped: "Fly downhill all the way."

Science came up with a theory called flight planning, a system which called for weather observation and utilization, the idea being to take advantage of the winds as much as possible. Why not, they reasoned, shop around, get reports on the prevailing winds and other phenomena in the area one wishes to fly and use the most advantageous route? The idea was to fly *with* the wind as much as possible, rather than attempt to buck it in order to fly a straight line.

It made sense. There was only one drawback however: Sufficient weather data were not available over all the routes. This deficiency increased as the range of aircraft increased. As more rapid means of communications developed, e.g. the telegraph, telephone, radio—weather coverage was considerably extended. However, flight planning was still accomplished manually and laboriously.

Eventually the idea of using electronic computers to calculate the best flight plan was raised. On July 1, 1954, the Joint Numerical Weather Prediction unit (JNWP) was formed at Suitland, Md., under the direction of Dr. George P. Cressman of Air Weather Service. Dr. Cressman and his staff were to continue research made by the Geophysics Research Directorate of the Air Force Research Center, Cambridge, Mass., the Institute of Advanced Study at Princeton, N. J., and other U. S. universities. Trial forecasts made by electronic computers at Cambridge and Princeton had indicated a degree of skill comparable to that of the best weather forecasters. It was then the weather services decided to set up a working unit. In February 1955, the IBM Model 701 was rented at a cost of about $20,000 a month. It was with this machine at Suitland that the first trial runs under the direction of JNWP were conducted. On May 6 daily weather chart predictions were inaugurated when Brig. Gen. (now Maj. Gen.) Thomas S. Moorman, Jr., then the AWS commander, pushed the button that activated the computer. Meteorologists, on that day, set the stage for numerical flight planning, the most significant advance in the utilization of weather data in 30 years.

How It Works

Numerical flight planning is the name given the system utilizing an electronic computer which receives weather data from all check points along a given air route, evaluates it, compares it with other routes from

the same starting point and destination and produces a flight plan showing the best possible route.

While there is nothing difficult about what the computer does, the speed with which it does it is phenomenal. Given the proper weather information twice a day, the computer can in one hour accomplish as many computations as one man working eight hours a day could accomplish in, conservatively, 50 years.

For example, Dr. Robert D. Fletcher, Director of Scientific Services, AWS, stated, "It takes a trained navigator about 25 minutes, on the average, to work out a flight plan across the Atlantic. With the 704 computer, four such plans can be turned out per minute, and the products are more accurate than the manually prepared ones. It costs 50 cents to prepare a flight plan on the Suitland 704 operating at $120 per hour. The particular example I am citing requires 1,300 flight plans per day over various routes, of which the machine proceeds to pick the 50 best from the point of view of least time in flight."

Numerical flight planning is out of the planning stage; it has been proved practical by the Military Air Transport Service in both the Eastern and Western Transport Air Forces. In May 1959, EASTAF was asked to conduct operational tests on these newly developed numerical flight plans. After tests, including six transatlantic flights, were completed, Air Weather Service Detachment in Washington, for whom the tests were being conducted, received word that EASTAF was enthusiastic about the results. Tests were continually expanded until the end of October when the final phase, including a program for the best track and split-level flight plan, was completed. The split-level plan is useful for aircraft that change altitudes in flight. EASTAF confirmed that numerical flight planning was more accurate than manual planning.

Early this year WESTAF tested numerical flight planning between Travis AFB, Calif., and Hickam AFB, Hawaii, with great success.

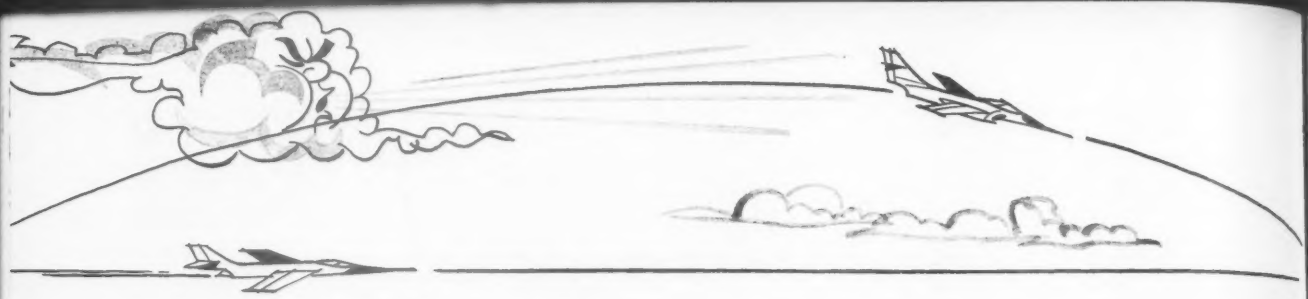
Perhaps the most important virtue of numerical flight planning is that it is constant; at any time of day or night weather information is available about any air route included in the program. Whether it is at Suitland, Offutt AFB, Cape Canaveral or any other weather center, a steady stream of information is continually poured into the electronic brain, keeping flight plans up to date.

The product of the 7090 computer, when calculating flight plans, reveals 14 facts concerning each 60 minutes of flight. Reading from left to right: first the latitude and longitude of the first check point; then the altitude at which that leg of the flight will be flown; the direction of the wind; the wind velocity; true air speed; ground speed; the distance of the leg in miles; the total distance of the flight from the point of origin; the estimated time enroute of the leg; the estimated time of arrival at the next check point; true course; true heading; and wind factor.

The future of numerical flight planning could be bright. It is now possible to have one weather center which can receive weather information from every check point of every known flight leg in the world, evaluate it and transmit the findings to whomever is flying in any particular sector. This same center could be used by every flying command—SAC, TAC, MATS, etc. In fact SAC is in the process of installing computers for this purpose.

NAVIGATION INFORMATION ROUTE NO. 1 T/O TIME 1500Z AVG RT WF 22

TO LAT/LON	ALT	WIND	TAS	GS	ZDIST	TDIST	ETE	ETA	TC	TH	WF
41.02/67.46	200	279/60	250	305	305	305	60	1600	78	73	55-
41.40/61/17	200	288/50	250	295	295	600	60	1700	82	77	45
41.55/54.57	200	299/41	250	284	284	884	60	1800	87	82	34
41.50/48.52	200	310/28	250	272	272	1156	60	1900	91	87	22
41.27/43.01	200	257/14	250	263	263	1419	60	2000	95	96	13
40.48/37.22	200	214/24	250	259	259	1678	60	2100	99	104	9
39.53/31.56	200	207/27	250	254	254	1932	60	2200	102	108	4
38.48/26.60	200	181/ 9	250	248	237	2169	57	2257	105	107	-2



Of the future? Dr. Fletcher predicts that, "Within five years the computer program will include a continuous series of automatic analyses done each hour.

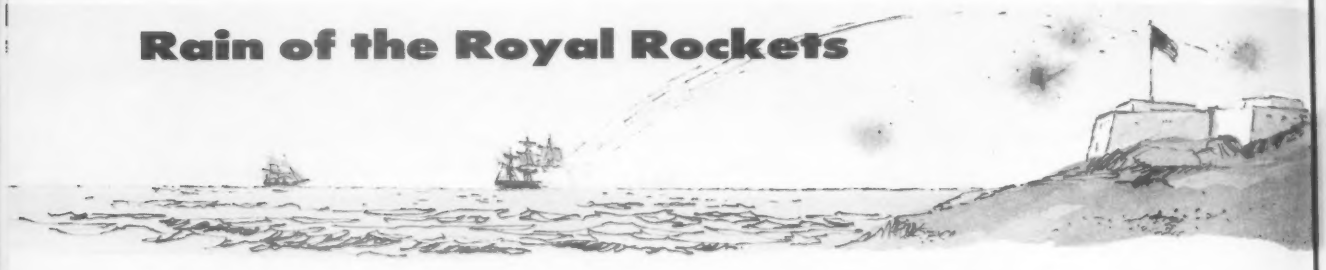
"Throughout the next ten years there will be an increasing trend toward machine processing of meteorological data to produce 'finished products,' whether these be descriptive charts for customer display or predicted operational data which are automatically fed into a user's operational-control system.

"Within the next ten years computers will utilize grid networks an order of magnitude closer than are now used, and will turn out forecasts of severe storms and local phenomena. I give airport terminal forecasts four years, thunderstorm forecasts six years, and tornado forecasts eight to ten years.

"Within five years computers will be doing global analyses and prognoses.

"I hope I have been pessimistic."

Rain of the Royal Rockets



The rockets used against American forces during the War of 1812 were of the ground-to-ground and ship-to-shore types. The missiles were equipped with interchangeable warheads and could be adapted to the requirements of a given mission. The choice was between solid iron shot, explosive shell, and an incendiary bomb containing a furiously burning mixture of pitch, powder, tallow, and saltpeter.

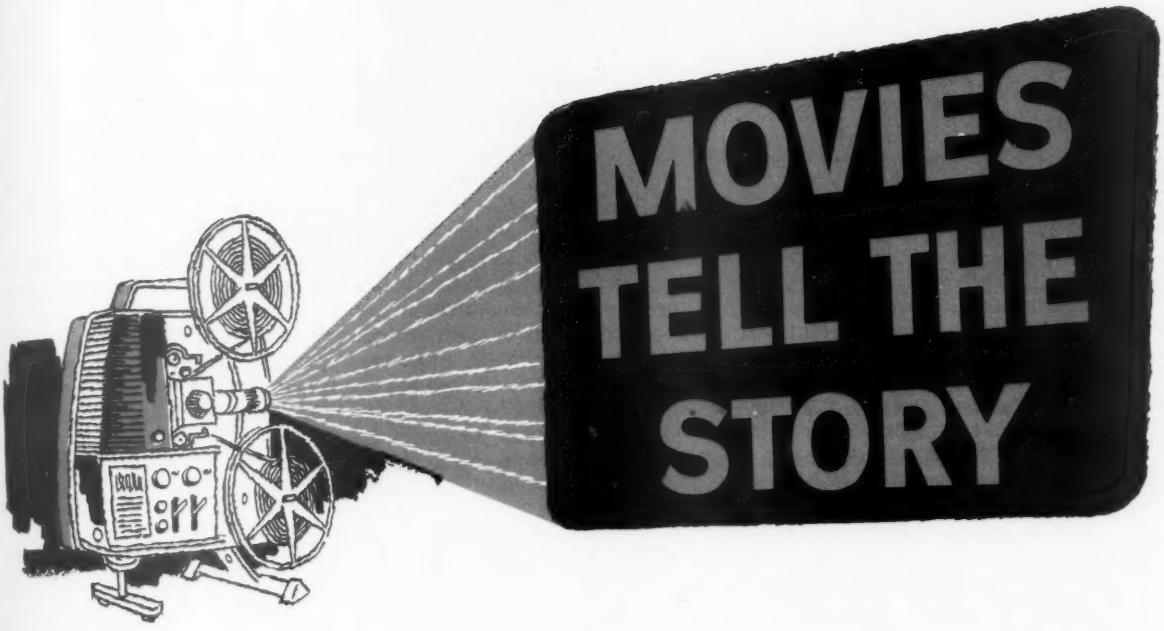
Easily the more formidable were the ship-to-shore missiles. These weighed 32 pounds, of which 24 pounds represented the warhead. Maximum range was in excess of a mile. The ground-to-ground rockets were three- and six-pounders, with ranges of 1,800 and 2,300 yards respectively.

H. M. S. Erebus, whose weapons put the "red glare" into the lines of our national anthem, was the only rocket cruiser afloat in the world when she bombarded Fort McHenry in the unsuccessful British attempt to capture Baltimore. The *Erebus* could launch a salvo of 20 rockets in a single broadside. The rockets were fired from metal tubes encased in a boxed wooden chute which extended down into the hold from square holes cut in the ship's side. The tubes were equipped with gunlocks and the rockets could be ignited for launching by pulling a lanyard.

The launching tube-chute system could be raised, lowered, or traversed. Highest possible angle for launch was approximately 85 degrees. Only a few minutes were required to reload the rocket tubes. The 32-pound rocket had an 18-foot stick set in the center of its base to stabilize its flight. This was an improvement over earlier types which had the stick attached tangential to the base by means of metal hoops, but the change failed to produce a major improvement in accuracy for the weapon. Nevertheless, the new missiles had important value when used against an area target, such as a city, or when employed for psychologically demoralizing effect. The rockets were credited with almost twice the penetrating power of contemporary conventional projectiles when attacking earthwork or masonry fortifications.

The ground-to-ground missiles were served by the Rocket Troop of the Royal Artillery. Old prints show the detachment resembled in appearance a battery of horse-drawn artillery. The launcher, a long trough-shaped device, was mounted on a gun carriage in place of the cannon. The rockets were carried in an oversized version of the artillery caisson. Under rocket fire for the first time on August 24, 1814, several green American units panicked in the Battle of Bladensburg, near Washington, D. C., although actual casualties from rocket fire were small. In the resultant confusion, conflict of orders, and inept tactical moves, the American position steadily deteriorated and the British won the field, subsequently capturing the Nation's Capital which had been stripped of defenders.

—WILLIAM A. KINNEY



by Dave Karten, *Airman Staff*

An instrument-packed Atlas screams upward from its Cape Canaveral launching pad, noses over toward the southeast and blazes a 9,000-mile path to its target area just south of Madagascar in the Indian Ocean. High over the Eglin proving ground a B-52 looses its supersonic, harpoon-shaped, air-to-ground GAM 77 *Hound Dog* missile at a target hundreds of miles away.

In each case USAF cameramen are there to lock their sharply focused movie cameras on the scene and record it. The filmed records of these and other events in the continuing Air Force drama become motion picture releases. Their dual purpose: to help tell the Air Force story as almost no other medium can, and provide an invaluable training tool in the technical instruction of USAF personnel.

The Air Force Film Library system now contains nearly 50,000 miles of training, orientation and information film. The exchange has in circulation more than 280,000 film prints covering almost 4,000 subjects and embracing nearly every phase of Air Force activity. There are films explaining ways to develop individual qualities of leadership. There are others that show how to increase job skills, assemble new equipment, or operate complex weapon systems.

Many films in the Air Force film system have also been extremely popular among Reserve units and certain civilian groups to whom general releases are available on application. Churches, youth groups, civic and patriotic organizations, and defense contractors draw on them heavily.

Other customers are Department of Defense and other governmental agencies, air attaches and military missions. In addition, base information officers make many films available to television outlets for use on locally produced programs.

Films are supplied through 135 USAF film libraries located at installations around the world. Hub of the library system is the giant Air Force Film Library Center, 8900 South Broadway, St. Louis, Mo. Major overseas centers are at Chateauroux Air Station, France, and Tachikawa AB, Japan.

An Air Photographic and Charting Service (MATS) activity, the St. Louis exchange operates the extensive AF film distribution system and provides professional and technical services to help users obtain the utmost value from films borrowed.

Nearly a thousand film requests pour into the Air Force Film Library Center's mailroom daily, but a well organized distribution system insures arrival of a film anywhere in the world on time.

Probably best known of all productions distributed by the system is the monthly *Air Force News Review* which is circulated to more than 650 addresses. Designed to keep airmen abreast of developments in all areas of interest to military personnel, the *Review* finds its way on regular schedule even to remote installations.

Distribution experts also work out the circuits that place Commander's Call films at every installation on schedule. After completing these circuits, the films again go out on special circuits to AF Reserve, AFROTC and Civil Air Patrol units, Air Attaches, and others.

Likewise, Hq USAF or a major air command may earmark some films for immediate distribution to certain activities. In this category are, for example, Flying Safety Reports that must reach 246 activities within a short period.

These carefully planned circuits make possible maximum film utilization with a minimum number of prints. For example, an air command may request that 180 units under its jurisdiction receive a new training film on a two-week loan basis within a specified time. By using the planned circuits the AF Film Library Center accomplishes this important mission with 60 prints instead of the 180 that would otherwise be necessary. Rapid inspection and repair of films as they return holds "film mortality" to a minimum. As a result no important training session is delayed or canceled because of damaged film.

To assist in the selection of films, a publications and information program provides guides to available motion pictures. These are AFM 95-2, *Air Force Film Directory,* and AFM 95-4 listing classified and atomic energy subjects. A new directory, AFM 95-8, issued 1 June 1960, gives running time, and related data of over 400 selected films authorized for public and television exhibition.

Film distribution announcements are sent out to the field to insure timely information on pending revisions, supplements and changes to the manuals. Through a field liaison program, educational specialists provide personal consultation services and professional assistance in the selection and use of these films.

In addition to listing the titles of films in the distribution announcements, a brief resume of each is listed. Films authorized for public showing are indicated by the abbreviations PE, TV, TH and UWF, which stand respectively for nonprofit public exhibition, nonsponsored television, theatrical exhibition, and sale through United World Films, Inc. The abbreviations TF and SFP indicate Training Films and Special Film Projects.

Below is a partial list of recent film releases. With each title appears its film library number and a brief description. THE AIRMAN plans to publish further lists regularly in this new department.

SFP 1001. *Mission—Sonic Boom.* Beyond vision, beyond engine sound, out of the clear blue sky, comes the thunderlike sonic boom—the sound of security. Film takes viewer on a supersonic flight at 35,000 feet altitude. From the cockpit all is quiet and jet sound is left far behind. As the plane separates the air, much like a ship causes ocean waves, it builds up air waves that spread in a few seconds to the ground. This causes mild shock, slight vibration, and undivided attention of people, pets and livestock in exposed area. 11 minutes. Color.

TF 1-5292. *Survey of Astronautics.* Shows orbiting satellites and explains the variety of purposes they serve. Manned capsule satellite performs its mission of reconnaissance and space research. Shows what it will be like to be a member of the crew of a manned space station of considerable size and many-sided usefulness. 23 minutes. Color.

SFP 633. *Target Within Range.* A fast-moving Air Force film complete with sound, narration and color. In only 19 minutes running time, the film depicts the vital and diversified mission of the USAF Navigators as they work around the clock and around the world to keep our defensive and offensive airpower effectively poised.

SFP 1005. *Operation Worldwide.* Bob Considine recounts important events in the history and present-day activities of the Military Air Transport Service. Round-the-clock flight carrying food and supplies into Soviet-blockaded West Berlin in 1948 — airlifting wounded from Korean battlefields—or rushing troops to troubled spots in the world during emergencies are but part of the MATS story. Film shows how this global command is geared to support the Department of Defense airlift mission anytime, in anything, any where. 23½ minutes. Color.

SFP 619. *Arctic Airlift.* Depicts arduous training necessary to keep the Military Air Transport Service planes and crews geared to their wartime airlift mission in support of SAC activities in the Arctic. Also shows how MATS conducts this training at a substantial saving to the taxpayer. 11 minutes. Color.

SFP 660. *The Widest Horizon.* Covers past, present and future problems confronting man in his search to conquer space. Interviews with experts on space problems and future ideas and plans are also included in film. 28 minutes. Color.

Every year about 250,000 films are inspected, cleaned, and repaired as they are returned by exhibitors in the field. Basic purpose of the Air Force movie program is to provide more learning in less time.

A specialist assists visitors in the selection of films in one of the center's two review rooms.

SFP 1016. *Celestial Mechanics and the Lunar Probe.* Employs animation to explain complex arrangement of our solar system and points out important factors to be considered in computing a lunar probe. 10 minutes. Color.

TF 1-5301. *Nightmare for the Bold.* This is the unforgettable story of A/2C Mike Adams who faces a lifetime of regret because of an accident resulting from one careless moment behind the wheel. The legal and moral responsibilities that close in on Mike provide a suspense that holds your interest to the last scene. 53 minutes. B&W.

SFP 1008. *Beyond the Gravisphere.* Shows the problems encountered in feeding man in space and the efforts being made to solve these problems. Narrated by Alastair Cooke. 13½ minutes.

SFP 1036. *Air Force Ballistic Missile and Space Program.* Shows the development and construction program, planned and underway for the entire family of intercontinental ballistic missiles—*Atlas, Titan,* and *Minuteman.* 28 minutes.

SFP 1027. *Minuteman, Missile and Mission.* This film explains the capability and importance of the Minuteman missile weapon system to the United States Air Force. It explains the principles employed, the simplicity of operation and maintenance and stresses the reliability and flexibility of the missile and its launching platform. The qualifications and training required of Air Force personnel manning the system are described. 27 minutes. Color. Released 1960.

SFP 608. *The Air Force Missile Mission.* How each missile developed by the Air Force fits a specific requirement in the Air Force mission and how a balanced force of missiles and manned aircraft complement each other is vividly portrayed. Brig. Gen. James Stewart, USAFR, clearly and effectively explains this concept. 27½ minutes. Color. Released 1960.

SFP 1049. *Skywatch* describes the airborne alert conducted by B-52 bombers of the Strategic Air Command. The film portrays the activities of SAC crewmen as they fly mission problems while maintaining the shield of instant deterrent-readiness that protects the Free World from aggression out of any quarter.

SFP 1044. *Checkmate* is the story of the deployment overseas of mobile strike forces of the Tactical Air Command. By employing the services of aerial tankers to replenish fuel supplies, the supersonic tactical bombers and reconnaissance aircraft of TAC can be dispatched to any part of the world in a matter of hours. This high-speed tactical deployment is the Free World's protection against the danger of lesser disturbances which—if unchecked—could impede the uninterrupted pursuit of peaceful goals.

HOW TO GET FILMS

AF Form 253, "USAF Request for Film and Film Strips," should be used when requesting films by mail. For over-the-counter service, AF Form 253A should be used. Instruction for filling out the forms are on reverse side. Civilian groups may request films by letter direct to the AF Film Library Center.

Occasionally a film, especially a new one, may be temporarily out of stock because of unusually heavy demands. For this reason, alternate films and showing dates should be indicated when possible.

WHERE TO GET FILMS

Requests should be sent to your local base film library. At installations not having such a facility, a staff office normally is designated to take care of local film needs and requests should be sent there. If neither exists, requests should be sent to the appropriate library listed below:

CONUS (Except Alaska and Hawaii) send requests to:

AF Film Library Center
8900 South Broadway
St. Louis 25, Missouri

Overseas:

AF Film Library (Europe)
APO 10, New York, N. Y.
AF Film Library (Far East)
APO 323, San Francisco, Calif.
AF Branch Film Library (UK)
APO 218, New York, N. Y.

Alaska:

AF Branch Film Library (Alaska)
APO 942, Seattle, Wash.

Hawaii:

Base Film Library (Hickam)
6486th AB Wg.
APO 953, San Francisco, Calif.

Watch for new selected film releases in future issues of THE AIRMAN.

THE AIRMAN AS A CHRISTMAS GIFT

As the American people become more and more aware of the importance of the Air Force to the future peace and security of the Nation, so their interest in the day-to-day activities of the Air Force is intensified. Many airmen returning home on leave have become accustomed to torrents of questions from interested friends and neighbors. "How big is a B-52?" "What's the difference between a *Tiros* and a *Midas*?" "Why does the Air Force need planes and missiles?"

This home-town curiosity can be quite flattering, though it is sometimes a bit overwhelming. No one can be expected to describe every facet of the big picture. But the hunger for information expressed by our civilian friends is a normal, natural, and healthy reaction. It shows evidence of patriotic interest in the national welfare. It is good for the Air Force and good for the country.

All of which brings us to the point we started out to make from the beginning. There is no better medium for conveying information on Air Force life to friends and relatives than through the pages of THE AIRMAN. For that special person on your Christmas list who deserves a different and distinctive gift we suggest that you consider a subscription to the official journal of the Air Force. It costs $3.50 for 12 issues, and a convenient coupon appears on page 23. Allow about 60 days for delivery to begin.

An odd thing about the hunger for information mentioned above is that people place a premium on inside knowledge. "Right from the horse's mouth" is a time-honored expression in American conversation. At the home-town or grassroots level, the opinions and observations of a man who has a son in the Air Force are likely to carry more weight than a speech on television by an important general officer. By sending THE AIRMAN to your Dad—or to a kid brother—you will help him become better acquainted with history as it is created, and better equipped to discuss the important issues of the generation. He will also get a better appreciation of your role in the Air Force.

THE PRESIDENT AND THE ELECTORAL COLLEGE

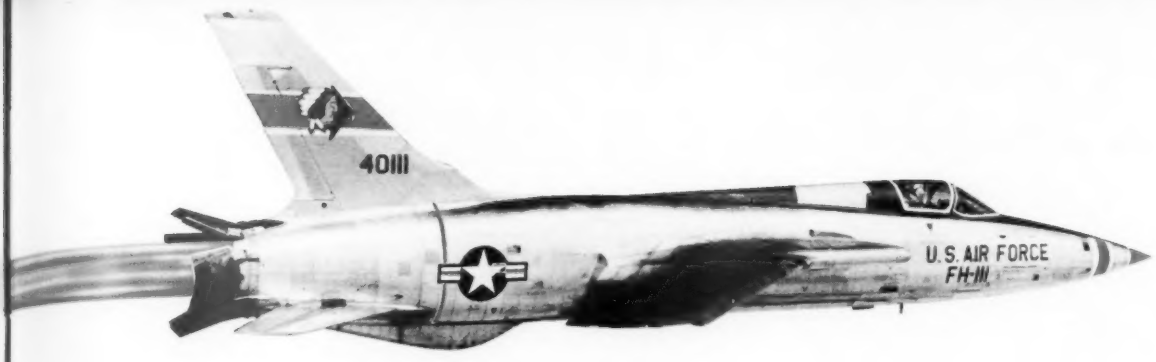
The President and Vice President of the United States are the only elective Federal officials not selected by direct vote of the people. They are elected by members of the Electoral College, an institution which has survived since the foundation of the Republic.

Article II, Section I, of the Constitution of the United States stipulated that each State shall appoint, in a manner determined by the State Legislature, a number of electors equal to the number of Senators and Representatives sitting for the State in the Congress. Senators and Representatives were not themselves eligible to serve as electors, nor was any other person "holding an office of trust or profit under the U. S."

These electors meeting in their respective States voted for two persons for the offices of President and Vice President. Results of these State-level ballots were transmitted to the President of the Senate who tallied the count for the entire country. The person receiving most votes became President and the second runner became Vice President.

As differences of opinion on how the Constitution should be interpreted laid the basis for organized political parties about 1790, it became possible — practically inevitable — that the President might be of one political party and the Vice President of the opposing party. This occurred in 1796 when John Adams, a Federalist, became President with 71 electoral votes and Thomas Jefferson, a Democrat-Republican, became Vice President with 68. When Jefferson became President in 1800 this electoral system gave him Aaron Burr as Vice President, which was unfortunate since the two men were temperamentally incompatible. This led to enactment of the Twelfth Amendment to the Constitution in 1804 providing for separate balloting for the two offices. By the 1820s most States had adopted popular election as the means of choosing members of the Electoral College, thus providing, in effect, for popular election of the President and Vice President as electors were pledged in advance to particular candidates. The Senate and the House of Representatives meet as one body on January 6 following the election to tally the vote of the Electoral College, but this has become largely a formality. It has become customary for political parties to nominate their candidates for electors at State conventions, and some States print the names of electors on the ballots and others print the names of the candidates endorsed by the parties for President and Vice President.

The first national conventions for nominating candidates was held in 1832. The National Republicans nominated Henry Clay as their candidate and the Democrats renominated President Andrew Jackson. President Jackson was returned to office with 219 electoral votes to Clay's 49.



Aerospace weapons of Tactical Air Operations,
Manned and Unmanned, they are

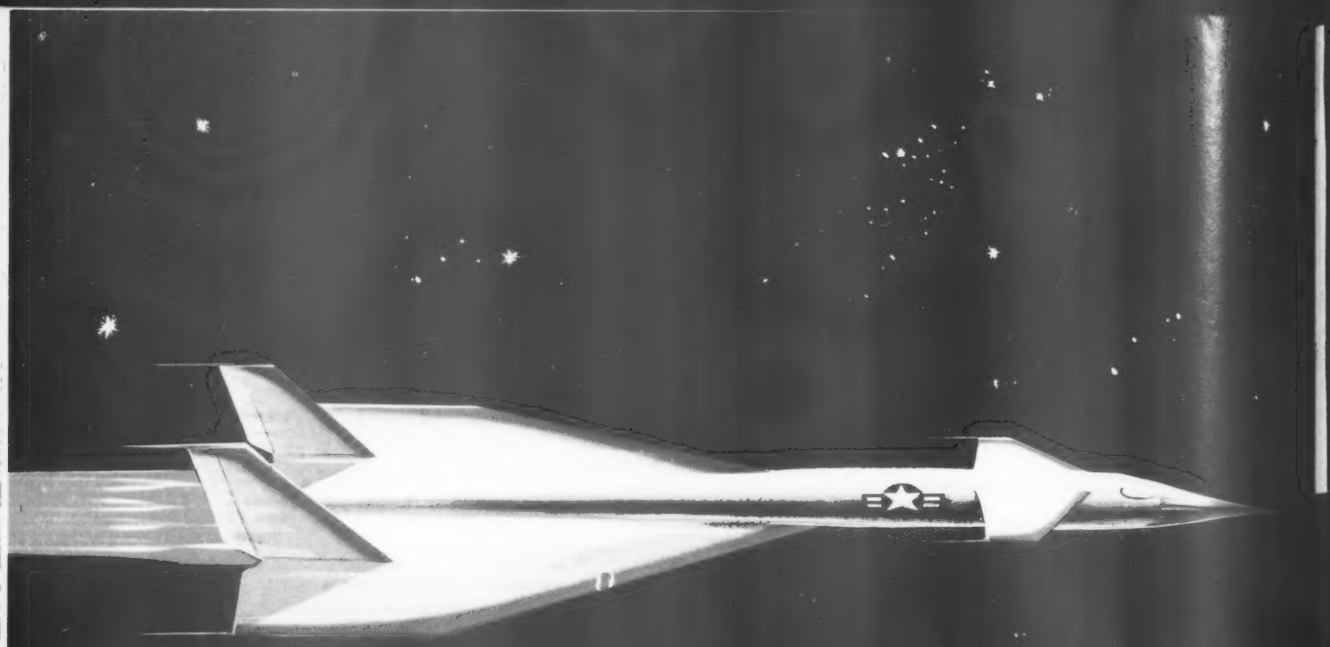
Paired for Peace

The *Mace* surface-to-surface guided missile, and the versatile F-105 *Thunderchief* are a pair of deadly tactical weapon systems with dual capabilities.

Both are effective carriers of either nuclear or conventional weapons, and represent formidable deterrents to the outbreak of small, or limited warfare. Part of the Tactical Air Command's flexible strength, they are also vital elements of this nation's deterrent arsenal against global aggression.

Now replacing the *Matador* overseas, the *Mace* operates above 35,000 feet at near sonic speeds. Built by the Martin Company, it is fired from an extremely mobile launching platform.

The F-105, a Republic Aviation product, is supersonic and can deliver a variety of weapons for air-superiority engagements, close support, interdiction missions and small war action.



There are other reasons frequently given for maintaining a mixed deterrent force of modern bombers and missiles. First, to rely exclusively upon missiles not only eliminates the versatility and flexibility of our future deterrent strength, but a modern mixed force means that a prospective enemy cannot rest easy until a counter to any and all combinations of weapons has been developed. To narrow the field of choices in delivery systems makes the enemy's defensive job commensurably easier and immeasurably cheaper. Some believe that the mere building of the B-70 in sufficient numbers would force the Soviets to enlarge their commitment for home defense to the extent that it would cost them more to defend against the B-70 than it would cost the United States to build the plane.

From Supersonic Air Transports
A report of the Special Investigating Subcommittee to the Committee on Science and Astronautics, U. S. House of Representatives, Eighty-Sixth Congress, Second Session